JUNE • 1955
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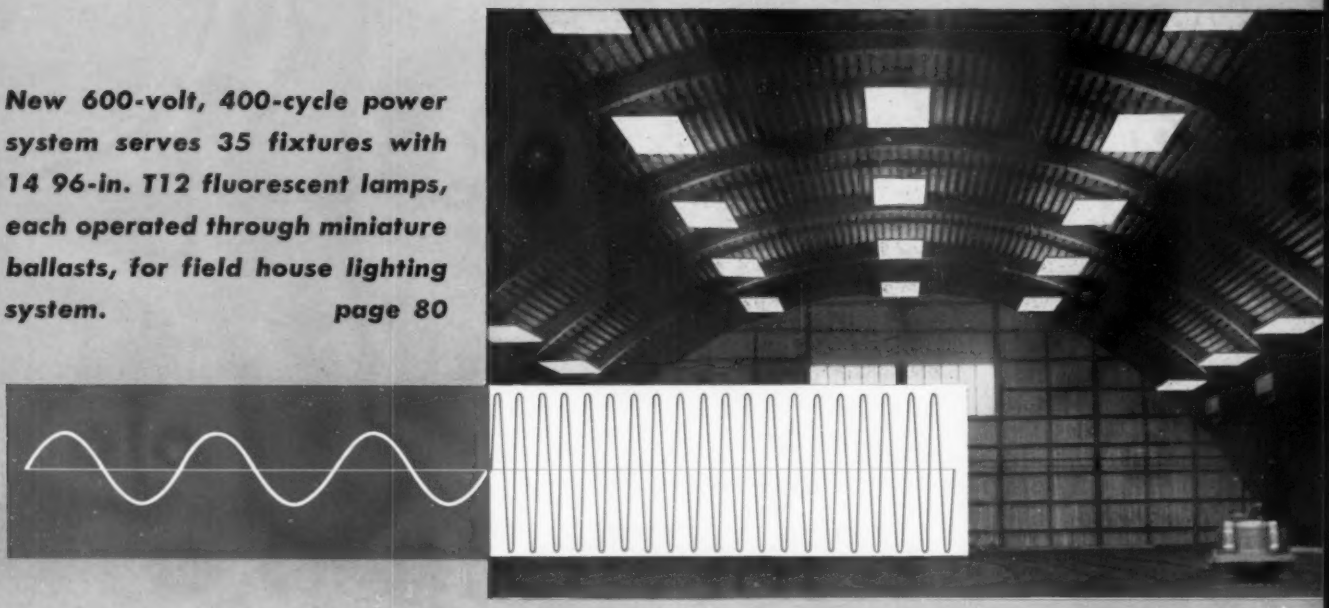
ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING



New 600-volt, 400-cycle power system serves 35 fixtures with 14 96-in. T12 fluorescent lamps, each operated through miniature ballasts, for field house lighting system. *page 80*

MODERNIZING APARTMENT HOUSES — a special report on design requirements, layout and installation methods for rebuilding electrical systems of existing multi-family dwellings to accommodate contemporary lighting and appliance loads. page 69

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and Plastic Electrical Tapes *

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MANUFACTURING COMPANY
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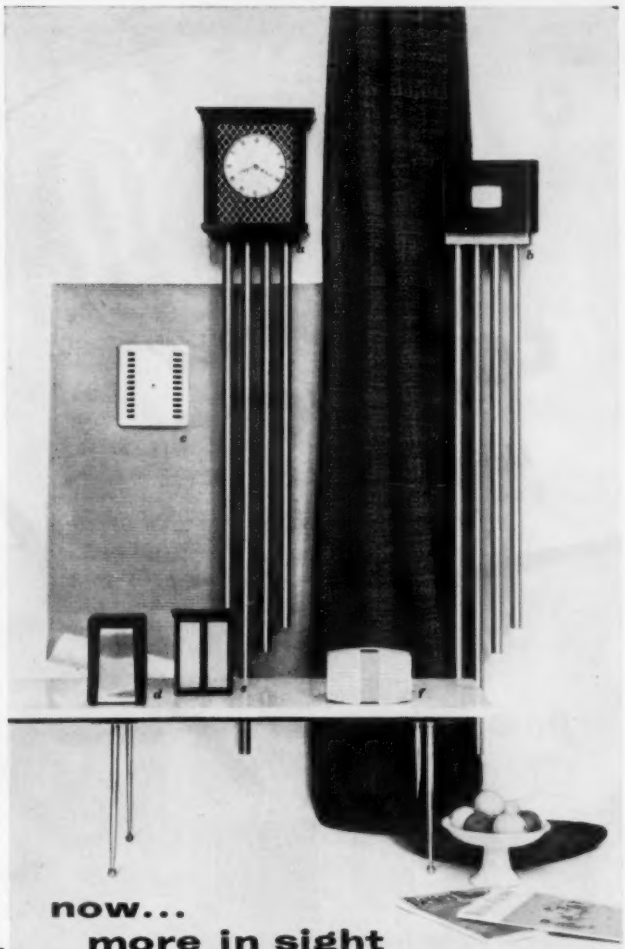

now... more in sight in sound in chimes by EDWARDS

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ebony or white... 2 note and Vibrechord.

CADET
white or mahogany... 2 note and single note.

WEDGWOOD
ivory case, 2 note and single note. 2 or 3 tubes.

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recessed chime, white... 2 note and Vibrechord.

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mahogany or white marble, 2 note and Vibrechord.

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...om, it "sings" ...long as a finger lingers on it!

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At hardware or electrical dealers — or write for full color brochure and name of nearest distributor.

***Wait till you hear Edwards exclusive Vibrechord sound!!**

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No Other Liquid Tight Flexible Conduit Connectors Have The APPLETON Brass Ferrule. Ferrule Screws In and Crimps On For a Perfect Seal and Positive Ground

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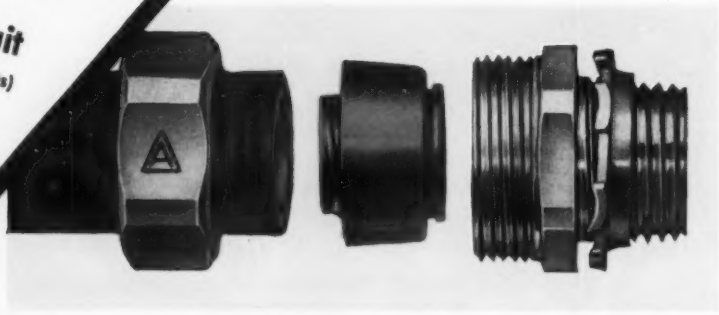
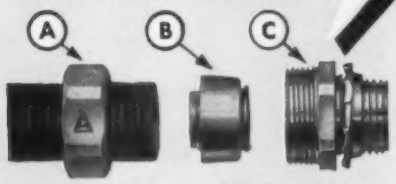
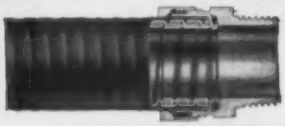


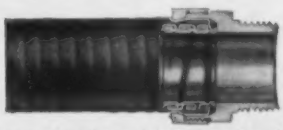
HERE'S HOW THEY WORK:



Slide nut (A) over conduit. Screw ferrule and sleeve assembly (B) into conduit. Tighten nut onto connector body (C).



Completely assembled "ST" connection. (IMPORTANT: nut must be tightened as far as possible to complete compression action which assures liquid-tight seal.)



Cross section of completed connection shows how tapered end of nut compresses ferrule wall . . . seals perfectly and gives positive ground between conduit and connector.

The Only Fittings of their Kind . . . Provide *Positive* Wiring System Protection

● Here are flexible conduit connectors with a big plus! Nothing to come loose, deteriorate, crack or break! Brass ferrule *Appleton* "ST" Series Connectors stay tight to assure positive exclusion of liquids, fumes, chips, shavings and other foreign matter from machinery electrical systems. And since the threaded, brass ferrule is crimped on, there is a *permanent* ground between conduit and connectors that maintains voltage unfailingly within 10 millivolts drop.

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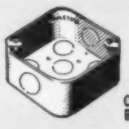
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ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The Electragist and Electrical Record — Established 1901

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Sidelights

APARTMENT REWIRING—Problems of inadequate wiring which beset most homes built before the war and many built more recently are even more acute in apartment buildings. Original wiring designs anticipated a few lights, a refrigerator and the occasional use of a toaster, vacuum cleaner or electric iron. But the apartment dweller has acquired the same tastes for modern electrical appliances as the home owner.

The acquisition of a broiler or a room air conditioner by a home owner does not necessarily create a wiring crisis. The acquisition of several such devices by several occupants of an apartment building can, and very often does, create an immediate, serious and often dangerous overload.

A ban on appliances can be only a temporary expedient. The owners are faced with a choice of rewiring or accepting a rapid deterioration in rental values. If he chooses rewiring it will be costly and will almost certainly require substantial rent increases. There is no easy out for either tenant or landlord.

The apartment wiring crisis throws a heavy burden of responsibility on the electrical contractor. The needs are largely technical, in a field where neither tenants nor owners can be expected to be particularly competent or understanding of values.

The contractor will find "Modernizing Apartment Houses", a special report beginning on page 69, a useful guide to design requirements, planning and installation methods. He may also find in it much useful data that will help explain to his customers the essentials of apartment rewiring.

SOUND—Commercial sound systems present a market opportunity that many electrical contractors overlook. While there are good specialists in the field, they cannot have the close contact and "inside track" with potential customers that electrical contractors must develop and maintain in the normal course of their day's work. The opportunities for music systems, paging and communication are endless and the potentials have hardly been scratched.

Modern equipment is rugged, stable and reliable. The electronic engineering is all built in at the factory and need not concern the installer. Speakers, components, and wiring are standardized and need only proper selection, installation and connection. There are few complications and no mysteries that should bother any experienced electrical contractor.

Beginning next month we shall present a series of articles about sound systems and their application and installation for electrical contractors. The articles are, as far as we know, unique in sound literature, notably in the absence of electronic circuitry. Watch for the first of this original and exclusive series of valuable articles and data in your July issue.

SPEC ISSUE REPRINTS—Since shortly after the mailing of the big May specification issue requests and inquiries about reprints have been pouring in. These will be processed as quickly as possible. In the meanwhile here are the most common questions and answers.

Will the editorial section on electrical specifications be available in reprint form?

Yes. In photo-offset reproduction in one color.

When will reprints be available?

About June 20.

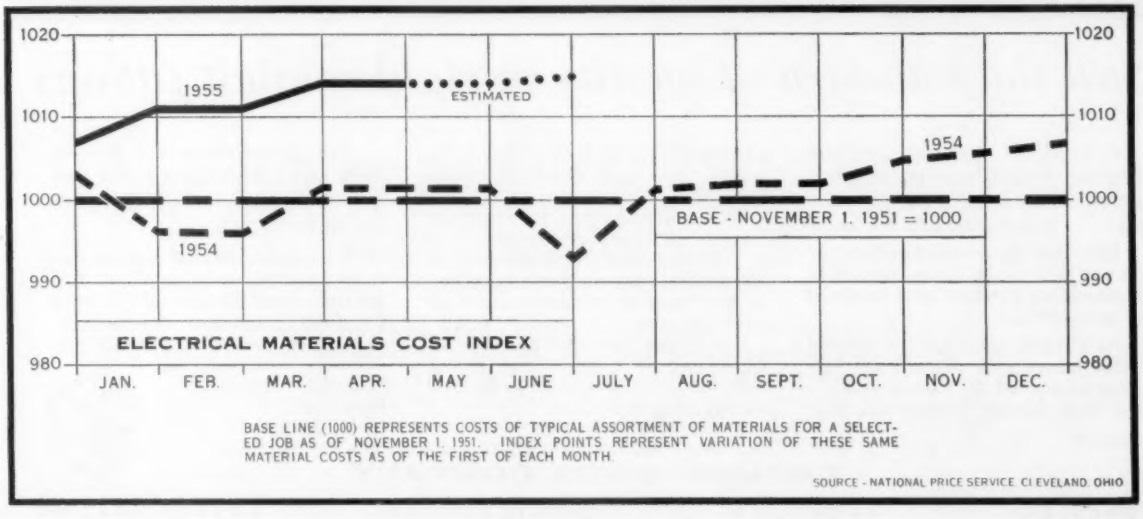
What will they cost?

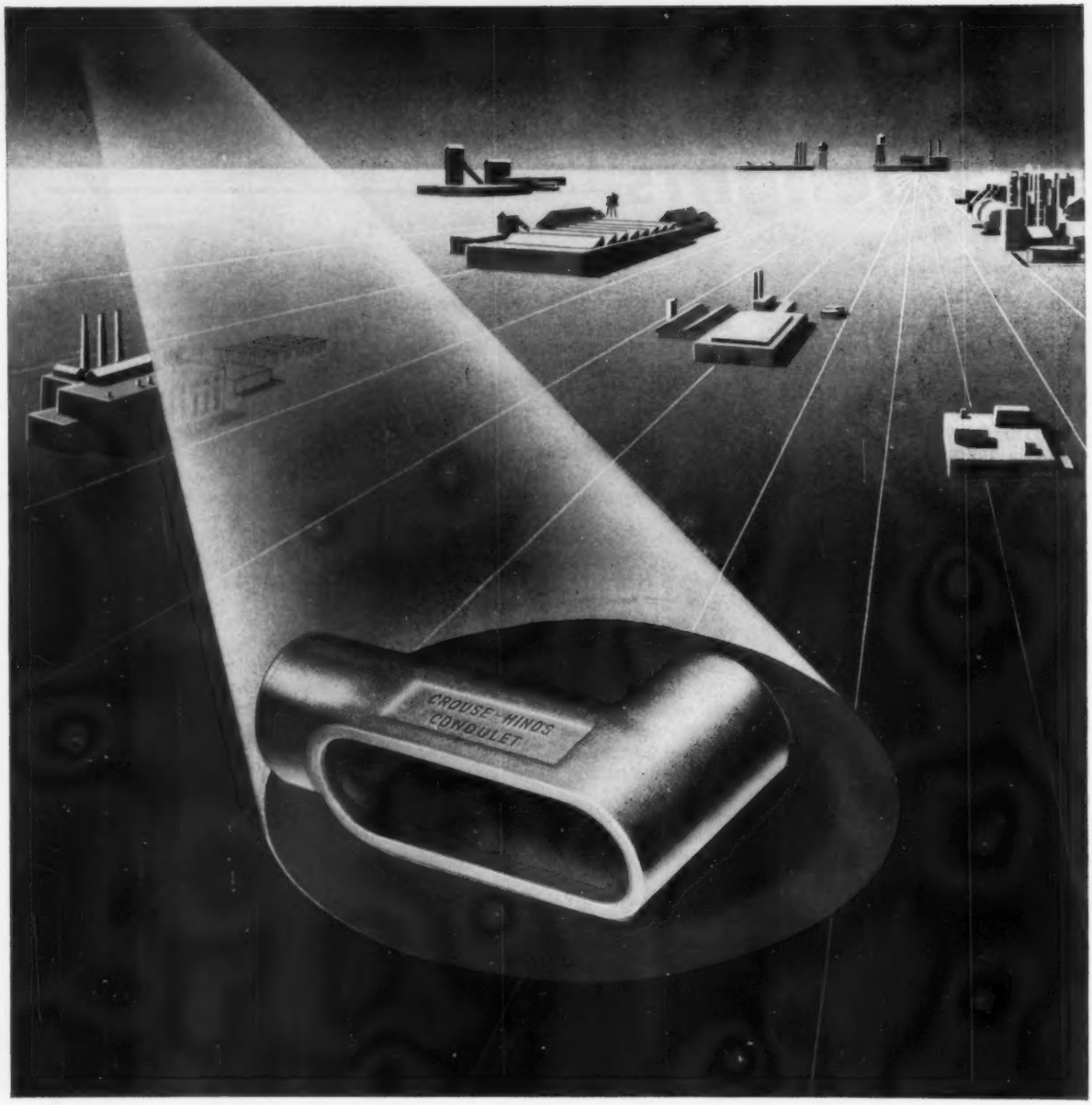
$1.00 each.

Are copies of the full issue available?

Only a very limited quantity. Please do not order issue copies if reprints will serve.

Please address your reprint requests to the Editorial Department.





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Condulets* have been widely imitated since Crouse-Hinds introduced them more than 40 years ago . . . *and that's all to the good!*

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CONDULETS FLOODLIGHTS TRAFFIC SIGNALS AIRPORT LIGHTING

Washington Report

Impact of automation on the national economy is being investigated by a subcommittee of the Congressional Joint Committee on the Economic Report, chairmanned by Rep. Wright Patman (D-Texas). Object is to establish policies needed to insure "proper distribution of productivity gains, and minimum unemployment and dislocations", which might result from shorter work weeks, etc., brought about by automation.

Concurrently a new Section has been set up within Electrical Equipment Division of BDSA, Dept. of Commerce, to handle military and civilian problems relating to synchros and servo devices. George H. Compter, of Ford Instrument Co., Hillside, N. J., has been appointed as industry consultant to this Section to serve for a period of six months or longer, on a rotating system of experienced industry personnel to BDSA.

A materials control system designed to permit rapid industrial mobilization in case of war has been outlined in detail in a new 41-page booklet recently issued by the Dept. of Commerce. Title is "The Defense Materials System in Our American Industry", and it is available from Supt. of Documents, Government Printing Office, Washington 25, D. C. at 25 cents. Price and wage controls are not included in this plan, but are under consideration by ODM and other Government agencies, may be recommended to Congress before it adjourns this Summer.

Industrial defense is a job for management, according to the conclusions of an extremely high-level Industry Conference on Industrial Security held last December under sponsorship of Dept. of Commerce in collaboration with Dept. of Justice, with 33 leaders of a cross-section of American industry. An Industry Task Group from this Conference has outlined 1) How to reduce the effect of an enemy attack; 2) How to deal with espionage and sabotage; and 3) How to resume production quickly—in a booklet titled "Job for Management", available from Dept. of Commerce.

Non-Federal public works construction needs over the next ten years are estimated at over $200 billion, according to a summary prepared recently by Depts. of Labor, and Commerce. This average of $20 billion expenditure annually in the immediate future compares with the $8.6 billion peak for such construction in 1954, and is four times the cost of such facilities over the past ten years. Breakdown shows: highways—$92 billion; educational buildings—$41.5 billion; hospital and institutional buildings—$22 billion; water and sewage works—$25.3 billion; and "other" non-Federal public works—$23.2 billion.

Construction outlays set a new high for the first four months of 1955 of $11.6 billion, for an annual rate of nearly $41.7 billion. Actual outlays in 1954 were $37.2 billion. April construction was $3.2 billion. Construction at new peak rate this year included private residential, commercial, schools, churches, sewer and water facilities, public utilities, and highways. Commercial building also set a new monthly record in April.

Housing starts in April were 127,000 units, or at yearly rate of 1.3 million. That brings total starts for first four months to 422,000, close to the 1950 record, and out ahead of 1954's rate. National Assn. of Home Builders predicted recently that starts per year will reach two million by 1960, while savings bankers cautioned against overbuilding. Dept. of Commerce will report on rental housing vacancies, as surveyed by Census, during this Summer.

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TO AMERICAN BUSINESS...

Thanks for Taming a Wild Horse

This is a message of appreciation to American industry. The occasion for the message is the completion of our eighth annual McGraw-Hill Survey of Business' Plans for New Plants and Equipment.

To a considerable degree, our appreciation is personal. It goes to the companies whose cooperation made our survey possible. Twice as many companies as in any previous McGraw-Hill annual survey carefully answered our questions about their plans to invest in new producing facilities. They gave a great deal of expensive time to the job. The cooperation of these companies, which employ nearly eight million workers, put the results of our survey on the firmest footing, in terms of coverage, it has ever had. For this cooperation we are most grateful.

But our appreciation is much more than personal. It extends in even greater degree to the kind of planning of investment in new plants and equipment which our survey revealed. The nature of this planning holds out promise that American industry is on the way toward bringing under control what historically has been one of the most upsetting forces in the American economy—the violent fluctuations in business capital investment. Progress in ironing out these fluctuations gives occasion for public gratitude.

A full report of the results of the eighth annual McGraw-Hill Survey of Business' Plans for New Plants and Equipment will be sent to anyone requesting it from the Department of Economics, McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York 36, N. Y.

Very Good Business News

The part of our surveys that attracts the widest interest is the news they give about immediate business prospects. And this year the news is very good. The survey results indicate that American business as a whole plans to invest $29.5 billion in new plants and equipment this year. That is 5% more than was invested last year, and a new high for any year.

Plans for the years 1956-1958 are also remarkably encouraging in terms of the amount of investment in prospect. American business reports that it is already planning to spend within 3% as much for new plants and equipment in 1956 as in 1955. In the past, the expenditures planned for future years have always been sharply lower than those planned for the current year. This is understandable enough. It is sometimes impossible to anticipate all the expenditures that will be necessary a year or more hence. Thus the fact that plans are already made

to spend almost as much in 1956 as this year is very good news about business prospects. The level of investment now planned for the years 1957 and 1958 is also remarkably high — far higher than ever reported for years that far ahead in previous McGraw-Hill surveys.

Taking the Long View

The fact that these plans exist is of immense constructive significance. It clearly indicates that more and more, and now in dramatic degree, American business is taking the long view in making its plans for capital investment. It is developing a program which, if successfully carried out, will go far toward eliminating the habitual, destructive surging and sagging of what is in effect the central power house of our economic system — capital investment by business. Upon the level of this investment depends not only the general state of our prosperity but our progress in raising the American standard of living with new products and new and better industrial processes.

Seven years ago, when we first asked industry to estimate its capital spending beyond the current year, only a small minority of companies could give us any estimates at all. This year, 87% of the cooperating companies—and it was a far larger number of companies—could comply with our request for estimates for the years 1956-1958.

It Pays to Bet on Growth

A number of developments help explain the increase in long-range planning of capital investment. One is the increasing technical complexity of American industry. It often takes longer, in this complicated age, to work out a successful installation of new plants and equipment. Another reason for long-range planning is American business management's increasing conviction that it pays to bet on the demonstrated capacity of the American economy to grow over the long pull. With this goes a corresponding determination not to let short-term business fluctuations upset individual company plans for growth through addition of new plants and equipment. An additional factor, and one of great and increasing importance, is the sense of public responsibility on the part of American business leaders who want to help prevent destructive swings in the levels of new investment.

It cannot be too strongly emphasized that there is still nothing automatic about the carrying out of these long-range plans for business spending. Actual expenditures are still governed in major degree by the general health of our economy. This is fully attested by the fact that the current business recovery has led to a substantial upward revision of the investment plans reported to us last fall when we made a preliminary check of plans for 1955. Either private economic excesses or a reversal of the recent improvements in federal tax policy could gravely upset realization of present plans. Fortunately, neither of these possibilities seems to be an immediate threat.

The very fact, however, that American business management has made these plans and will do its utmost to carry them out is a development of tremendous constructive importance for the American economy. It means that major efforts are being made to tame what historically has been an economic wild horse—the process of capital investment by business. Both for doing it, and for telling us about it in our annual surveys, we extend to American industry our sincere thanks.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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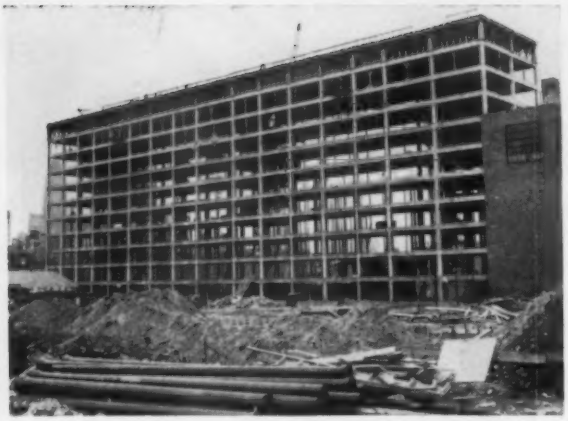

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World's Widest Range of Standard Steels and Steel Products

JOB: Newton Free Library Addition, Newton, Mass.
ARCHITECT: W. Cornell Appleton & Frank A Stearns, Boston.
ENGINEER: Thompson Engineering Company, Boston.
ELECTRICAL CONTRACTOR: Norfolk Electric Co., Boston.
AREA: Approximately 2,400 square feet.
FIXTURES: Luminous Lens Panels as follows:
4 10'-3¼" x 8'-0" each w/11-96T12 slimline lamps.
10 2'-9¾" x 8'-0" each w/3-96T12 slimline lamps.
2 2'-9¾" x 4'-0" each w/3-48T12 slimline lamps.
WATTS PER SQUARE FOOT: 2.9 approximately.
AVERAGE INTENSITY: On table tops, 75 footcandles in service. Average over room, 57 footcandles in service.
BRIGHTNESS READINGS: Walls .045 candle per square inch. Floor .019 candle per square inch. Table top .069 candle per square inch. Fixture—Across lamp axis: At 45°, 0.72 candle per square inch. At 30°, 0.29 candle per square inch.

The Torch of Learning *Glows More Brightly* with LITECONTROL Lighting

Geared for learning, planned for seeing . . . here's a library where high-level visibility goes hand-in-hand with high I.Q.

A custom job? Surely . . . *in everything but price!*

For LITECONTROL specializes in making a comprehensive line of standard fixtures for every conceivable requirement . . . and fitting them to specific applications for the best results.

Thus, with LITECONTROL you get the right light in the right place with the right appearance . . . at the least cost.

On your next job, call in your LITECONTROL representative.

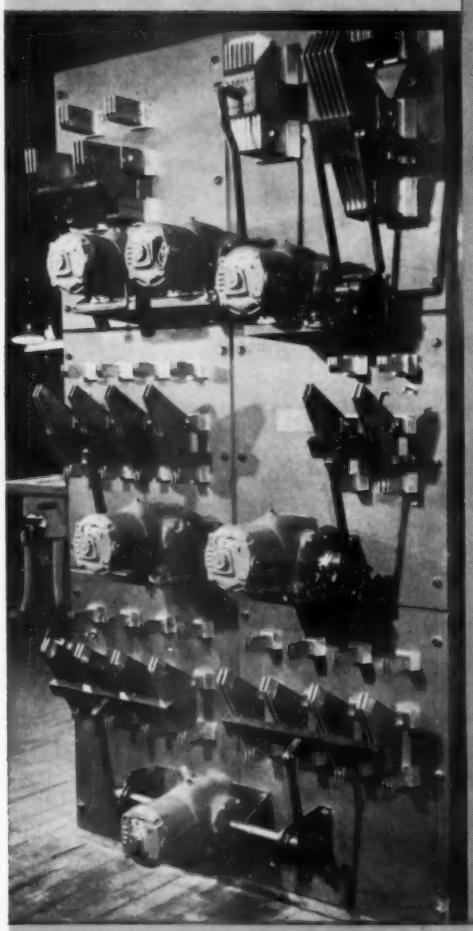
LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

Geared for smooth, slow speed



SIX Century Performance-Rated© GEAR MOTORS

power this remote controlled Automatic Switch. These gear motors are ⅓ H.P., 5 r.p.m., right angle shaft.

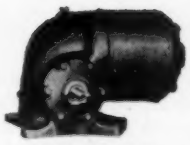
Whatever your slow speed needs . . . from 4.3 to 780 r.p.m. . . . Century Gear Motors provide compact, quiet-running units hardly larger than conventional motors . . . in ratings from ⅛ to 150 H. P.

For quiet, dependable service, helical gears with "rotational tooth contact" help prevent uneven wear and minimize vibration. Extra-width pinions provide strength for greater shock load resistance and longer life.

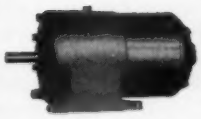
Tapered roller bearings enable the gear shafts to withstand radial and thrust loads without strain on the motor. Oil tight shaft seals make these motors particularly adaptable to shaft-down mountings on processing jobs where contamination is a problem.

Whatever the speed and power characteristics you need . . . AC or DC . . . Century Motors are Performance-Rated to do the job with top efficiency. For information, call your nearby Century Sales Office or Authorized Distributor.

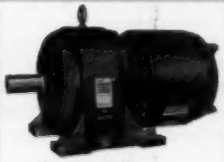
Parallel shaft, single reduction . . . 280 to 780 r.p.m. . . . ⅛ to 150 H.P.



Right angle shaft, single reduction . . . 25 to 280 r.p.m. . . . ⅛ to 3 H.P.



Parallel shaft, double reduction . . . 37 to 280 r.p.m. . . . ⅛ to 150 H.P.



Parallel shaft, triple reduction . . . 7.5 to 37 r.p.m. . . . 1 to 150 H.P.

Right angle shaft, double reduction . . . 4 to 84 r.p.m. . . . ⅛ to ¾ H.P.

Performance-Rated© Motors ⅛ to 400 H. P.

CENTURY ELECTRIC COMPANY

1806 Pine St. • St. Louis 3, Mo. • *Offices and Stock Points in Principal Cities*

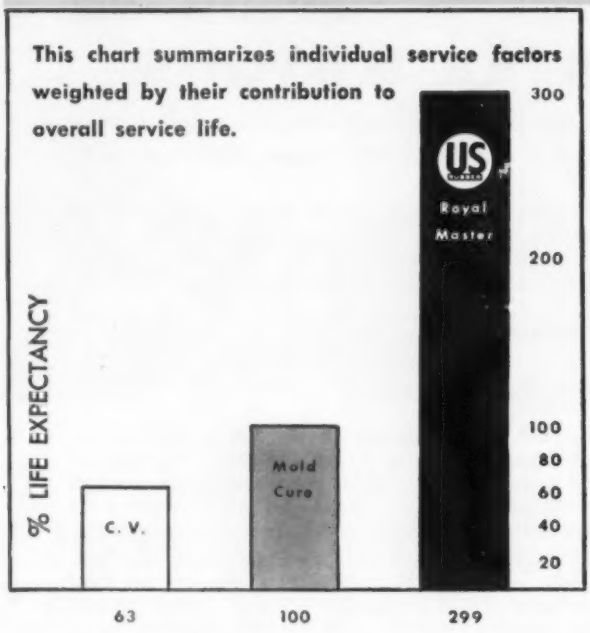
The crowning achievement

The NEW

PATENT HAS BEEN APPLIED FOR!

LOOK FOR THE NAME: U.S. ROYAL MASTER

Approved by the Penna. Dept. of Mines and accepted for listing by the U. S. Bureau of Mines.



Check the Facts!

- 26% greater *oil* resistance
- 33% greater *heat* resistance
- 38% greater *tension* or breaking strength
- 50% greater resistance to *cutting*
- 58% greater *abrasion* resistance
- 118% greater resistance to *tearing*
- 197% greater *impact* strength
- 488% greater *flexibility*

SUPERIOR!

Under impact, twisting and flexing the fibrous core (*inside* the annealed copper conductors) absorbs any strains and completely protects the conductors. This unique fibrous core also protects the conductors from any damaging *tensile* stress or strain.

SUPERIOR!

Patented Laytex® insulation gives the following advantages, found in no other cords:

• 90% unmilled grainless natural rubber with superior tensile strength and elongation • Unmatched aging and moisture-resisting properties • High dielectric strength • High insulation resistance • Easy stripping • Unexcelled physical and electrical properties • Perfectly centered conductors

US RUBBER

UNITED STATES

ELECTRICAL WIRE & CABLE DEPARTMENT

in portable cords!

U.S. ROYAL MASTER

outperforms and outlives average molded cord 3 to 1 and the average continuous vulcanized cord almost 5 to 1.

THREE YEARS AGO, "U. S." engineers began a complete reexamination of portable cord constructions, service life, and the causes of cord failure.

OVER 12,000 TESTS were made. More than a thousand cords of all leading makes, including our own famous U. S. Royal Cord, were analyzed, tested, and compared.

EVERY LIFE FACTOR was considered and carefully evaluated, alone and in its relation to overall cord performance and service life.

BACKED BY 65 YEARS OF EXPERIENCE in the manufacture of electrical wire and cable, U. S. Rubber engineers then translated their findings into an entirely new portable cord, designed to surpass any other previously made,

The new line of **U.S. ROYAL MASTER** Portable Cords is obtainable from your "U. S." Distributor today.

U. S. RUBBER IS THE ONLY WIRE MANUFACTURER to grow its own natural rubber, make its own synthetic rubber and its own plastics.

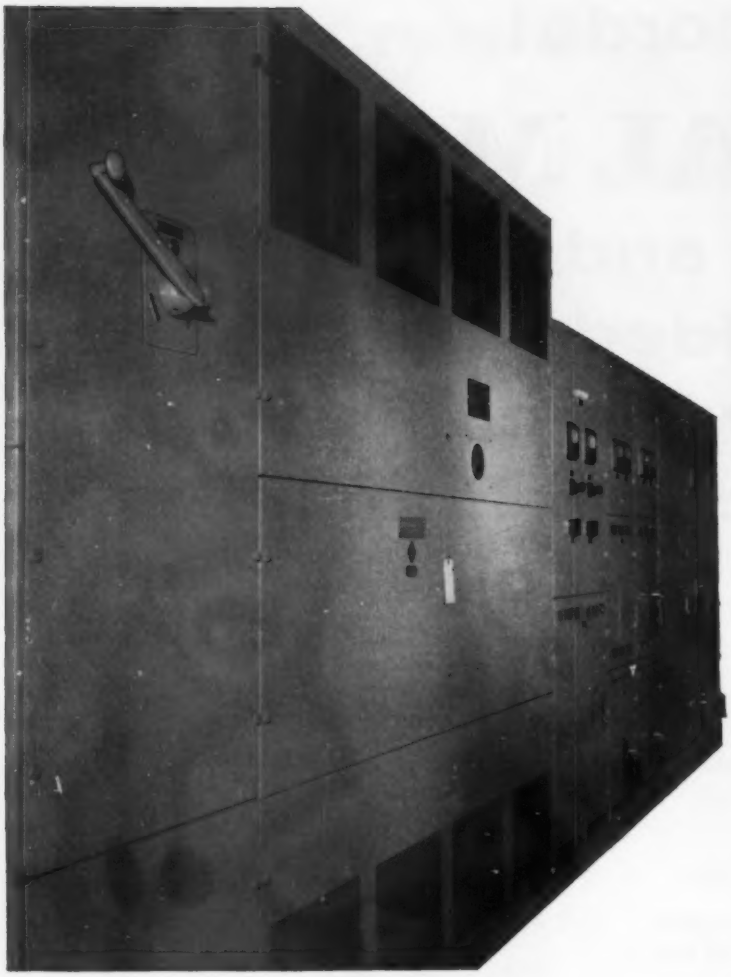
EXTENSIVE TESTS, BOTH IN THE LABORATORY AND IN OUTSIDE PLANT INSTALLATIONS, have proved this new portable cord startlingly superior in every respect!

THE NEW U.S. ROYAL MASTER is unquestionably the crowning achievement in portable cords. No other cord approaches it in performance and economy.

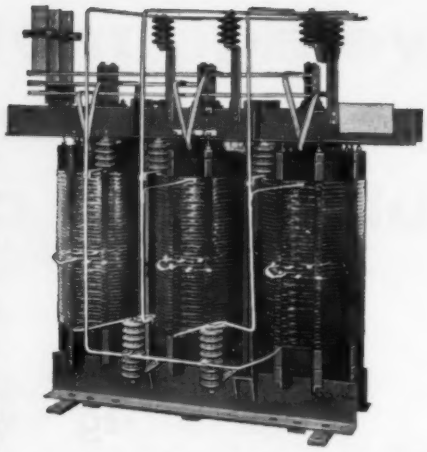
Approved by Underwriters' Laboratories, Inc.

RUBBER COMPANY

ROCKEFELLER CENTER, NEW YORK 20, N. Y.



Wagner®
TRANSFORMERS
... the choice of leaders in industry



predesigned power for PACKARD

Studebaker-Packard's new facilities are planned for greatly increased productivity—and part of that planning is a modern electrical distribution system, with plenty of unit substations to put power where it's needed at the right voltage for use.

This 2000 Kva, 4800 to 480 volt unit substation feeds power to stamping operations for Packard. Its heart is a Wagner dry-type transformer like the one illustrated.

Wagner unit substation transformers are "Predesigned." This completely eliminates individual job engineering because the standard ratings in which they are built are coordinated with the specifications of every unit substation builder.

When you specify Wagner "Predesigned" transformers you get the advantages of a proved design in a completely assembled and tested transformer —you reduce your costs—and get quick delivery.

Wagner unit substation transformers can answer your power needs just as they do at Packard. Choose Wagner for your next load-center installation. Consult the nearest of our 32 branch offices or write for Bulletin TU-205. It gives full information on Wagner Unit Substation Transformers for industrial power distribution systems.

Wagner Electric Corporation
6413 Plymouth Ave., St. Louis 14, Mo., U.S.A.

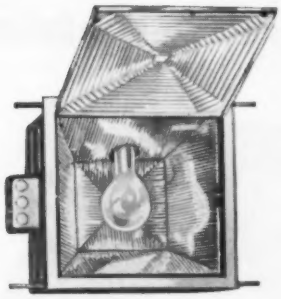
BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

WT55-6

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS–AIR AND HYDRAULIC

The Astounding Combination that gives you more than

70% USEFUL LIGHT



Some call it wonderful! Actually it is just excellent engineering. Proper reflector and proper lens control light! Any lamp bulb in the average fixture gives about 50% useful light. Put that same bulb in a KIRLIN Fixture with ALZAK GlasSurfaced reflector and a Kirlin wide angle 12″ lens and you get at least 70% USEFUL LIGHT!

Why You Profit with Kirlin

- ★ Installation Costs Are Less
- ★ Regular Building Wire Runs Direct To Heat-Insulated Junction Box
- ★ No Carpenter Work is Needed

- ★ Made in all sizes—square or rectangular—and in fluorescent
- ★ Alzak GlasSurfaced Aluminum reflectors
- ★ UL and IBEW labels
- ★ Hinged Rust-resisting Doors in Die-cast Frames
- ★ Individually packed for shipping
- ★ Spread-type or concentrating lens

You cannot get this winning combination in any other fixture AT ANY PRICE

●

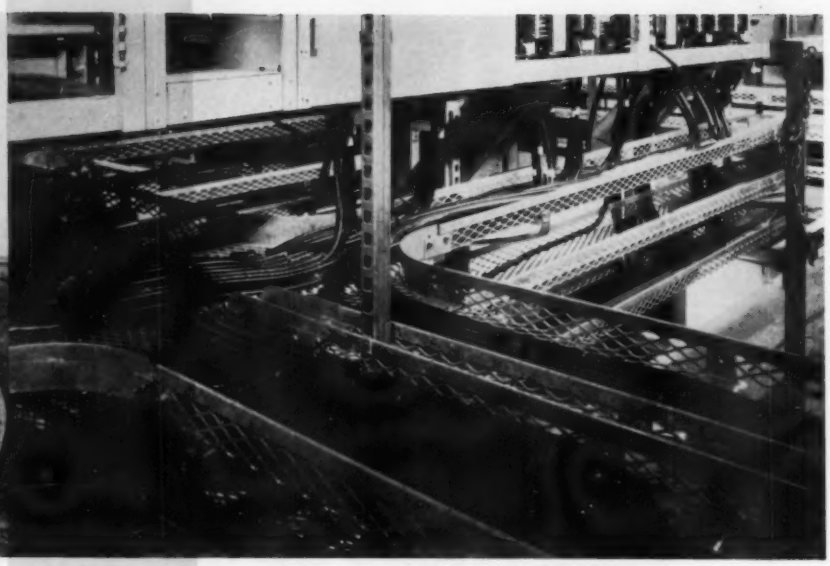
Any Kirlin representative or Kirlin distributor salesman can prove this to your satisfaction. Ask one of them.

IN STOCK AT LEADING WHOLESALERS EVERYWHERE

LARGEST SELLING RECESSED LINE—MILLIONS IN USE EVERYWHERE

The KIRLIN CO. 3435 E. JEFFERSON AVE. DETROIT 7, MICHIGAN

For rural electrification, RoMarine-RoPrene serves as the service entrance, as well as branch circuits between buildings.



RoMarine-RoPrene's light weight and smaller diameters make it ideal for trays, racks and other metal raceway installations.

You can cut cable

RoMarine-RoPrene is easy to pull in manholes and conduit or duct runs.

Full-Color Movie Tells Dramatic Story of Cable • CABLE PATHWAY OF POWER. A 45-minute feature film in sound and color, 16mm. Now available for showings to technical personnel. Write Rome Cable Corporation, Rome, New York, for bookings.

RoMarine-RoPrene is all-resistant to the effects of burial directly in earth, as in the case of this Fort Worth, Texas, International Airport installation.

costs with this *premium* cable

Yes, it is true that in the long run it often costs less to buy the best. RoMarine-RoPrene power distribution cable proves it. It has an enviable performance record. In construction, it combines high quality RoMarine, heat- and moisture-resistant rubber insulation, with the ruggedness of RoPrene (Neoprene) sheath. Economy results not only from its dependability but from its versatility, as well. RoMarine-RoPrene is one cable that can be installed aerially, in ducts and conduits, buried directly in earth or in runs combining all three. Widely accepted for power-distribution circuits, there are many instances where it becomes a money-saving building wire. It costs but little more than the cheapest . . . yet more than makes up the difference with long life and electrical stability.

How you save

Compared with cables having metallic coverings, RoMarine-RoPrene makes these economies possible:

- Lower original purchase cost
- Savings through reduced inventory
- Lower replacement costs
- Less termination and splicing expense with fewer accessories.

You get these advantages:

- Exceptionally long service life
- Ease of terminating and splicing
- Light weight and smaller diameters
- No fibrous or other coverings to deteriorate
- Immunity to the effects of electrolysis, corrosion and temperature extremes
- High resistance to oils, acids, alkalies, moisture, abrasion, flame and weather.

Where you can use RoMarine-RoPrene

Generally recommended for 600-volt service, RoMarine-RoPrene is ideal for a multiplicity of applications by electrical utilities, in industrial plants, for rural electrification, airport wiring and residential services.

It is specifically approved by Underwriters' Laboratories, Inc. as Type USE for underground service entrances.

It is approved by Civil Aeronautics Administration for airport wiring, when CAA Specification L-824, with Type A insulation, applies.

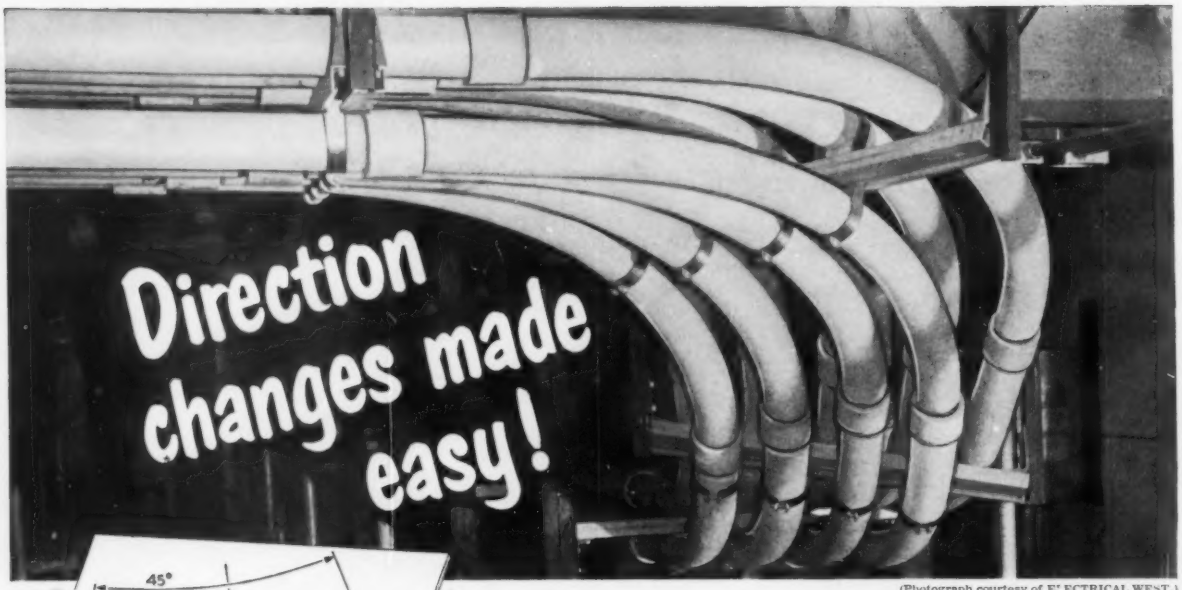
It has been proved a superior product for general purpose wiring and, except under circumstances of the National Electrical Code, can be unhesitatingly recommended for 75°C. operation.

It will pay you to check into the economy and serviceability of RoMarine-RoPrene power distribution cables. Detailed specifications and prices are yours for the asking. Write or phone today for Bulletin RR-2.

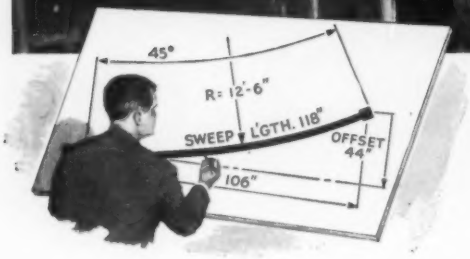
It Costs Less to Buy the Best

ROME CABLE ROME, N.Y.

ROME CABLE
Corporation
ROME · NEW YORK
and
TORRANCE · CALIFORNIA



(Photograph courtesy of ELECTRICAL WEST.)

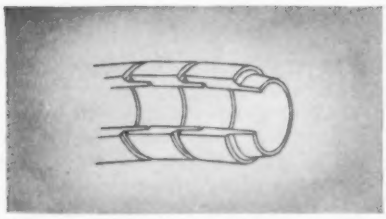


. . . with standard fittings for TRANSITE *asbestos-cement* DUCTS

When you use Transite Ducts, you have available a wide variety of standard fittings, made of the same asbestos-cement material as the ducts themselves. These fittings save time and expense because they provide maximum flexibility in laying out or constructing a duct system. They facilitate clearing unexpected obstructions or accommodating revisions in the original layout.

For instance, the new Transite 5° Bend Segments (shown at left) can be used alone to form simple and complex curvatures of any multiple of 5°. Used with other standard Transite curved fittings, they form curvatures of odd degrees. Thus, they enable you to simplify cross-overs and transformations . . . to clear obstructions . . . to form unusual or special bend or offset sections. They eliminate the need for purchasing special radii bends or sweeps. The other standard Transite fittings that facilitate directional changes are the offset bends, standard 45° and 90° bends, sweeps, curved segments, laterals, tees, elbows and deflection couplings.

For complete information write for new brochure EL-45-A, "Fittings and Dimensions of Transite Ducts." Contains all dimensional data required by the designer. Also available, "Transite Duct Underground Installation Sheet," EL-43-A. Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto, Ontario.



5° bend segment sketched in detail. It consists of a straight section of Transite stock with a male taper on one end and a female taper on the other . . . each machined at an angle of 2½° to the center axis. Segments can thus be used single, or combined to form bend sections whose curvature is any multiple of 5°.

Photograph showing use of bend segments and curved segments with Transite Ducts.

5 OTHER REASONS WHY TRANSITE DUCTS DO A BETTER JOB AT LESS COST:

1. Corrosion-Resistant. Transite, being made of inorganic asbestos and cement, resists corrosion and is immune to electrolysis.

2. Permanently Smooth Bore. Transite makes long cable pulls easy, under any conditions. Danger of damage to cables is also minimized.

3. Incombustible. Transite will not burn or contribute to formation of smoke, gases, fumes. It confines burnouts, will not soften under heat.

4. Higher Thermal Conductivity. Cables run cooler in Transite, reducing I^2R losses, increasing current capacity and prolonging insulation life.

5. Easy to Install. Transite Ducts are light weight, easy to handle. Joints are quickly made. Long 10-foot lengths reduce number of joints in line.

Johns-Manville TRANSITE® DUCTS

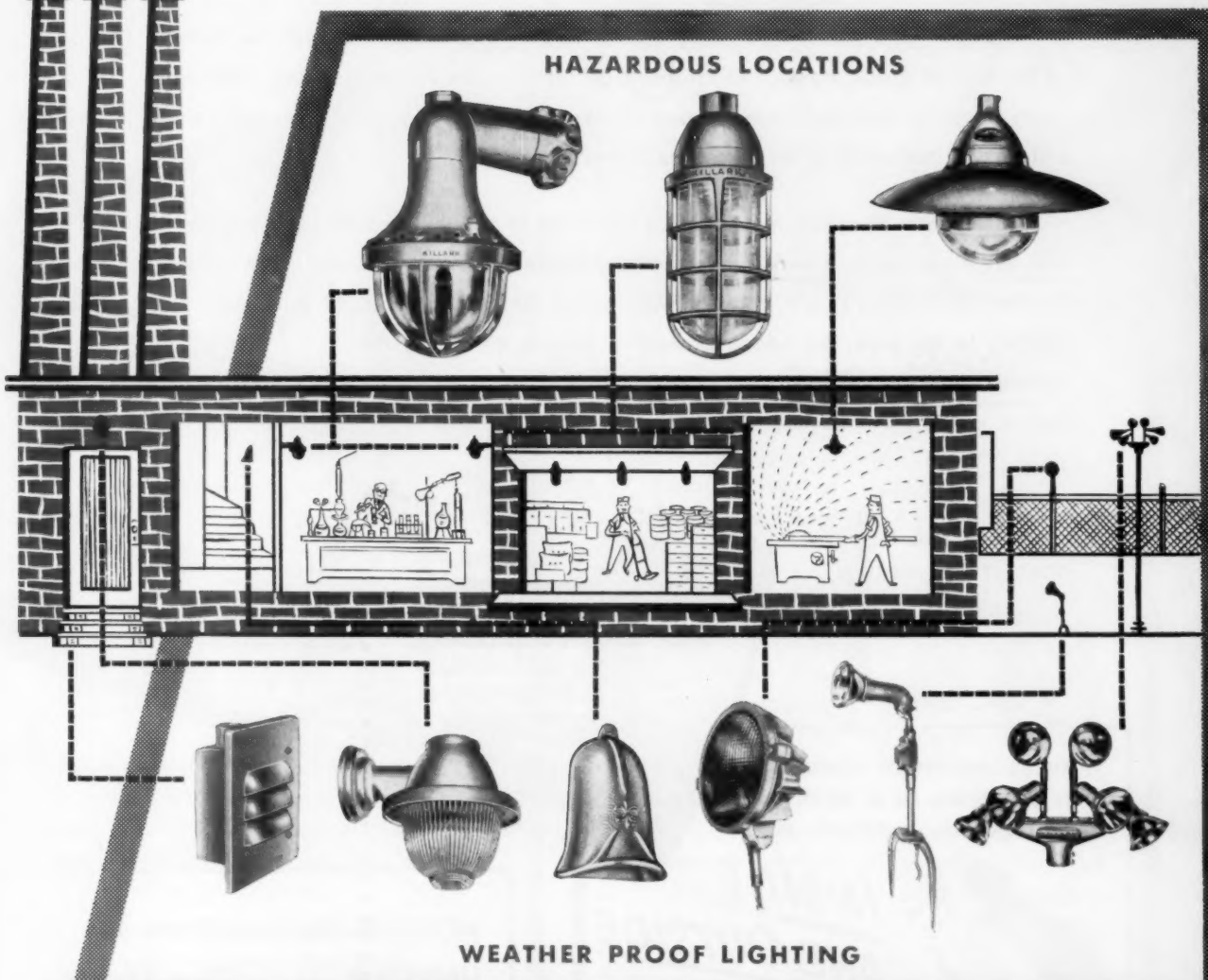
JOHNS-MANVILLE JM PRODUCTS

TRANSITE KORDUCT—for installation in concrete

TRANSITE CONDUIT—for exposed work and installation underground without a concrete encasement

KILLARK

INDUSTRIAL LIGHTING EQUIPMENT



KILLARK offers industry a complete line of lighting fixtures for every purpose—hazardous areas, general decorative lighting, outdoor lighting. And Killark fixtures offer more than just lighting efficiency . . . they are built for permanence (aluminum construction), are lightweight, have modern, sleek lines, and are the last word in lighting safety.

When the job calls for light . . . call for Killark.

KILLARK ST. LOUIS

Killark

ELECTRIC MANUFACTURING COMPANY

ENTRANCE FITTINGS • CONDUIT BODIES • FLUSH SWITCH FITTINGS • EXPLOSION-PROOF FITTINGS • VAPOR-TIGHT LIGHT FIXTURES • EXPLOSION-PROOF LIGHT FIXTURES • SEALED BEAM FIXTURES

Vandeventer and Easton Aves. St. Louis 13, Missouri

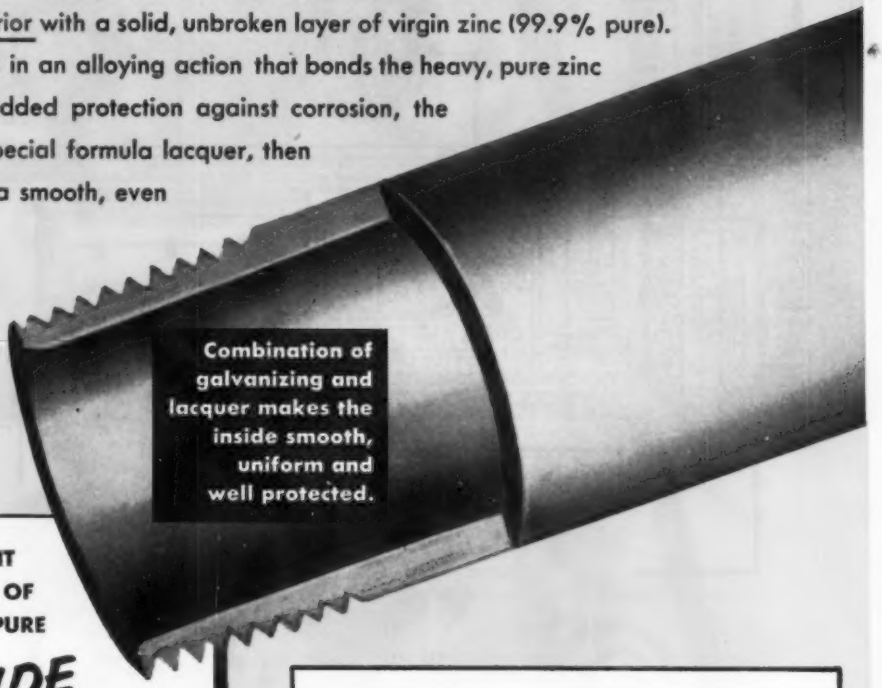
SALES OFFICES and WAREHOUSE STOCKS	Atlanta	69 Mills St., N. W.	Dallas	1903 Griffin St.	Philadelphia	2014 Chancellor St.
	Boston	49-51 D St.	Denver	1073 Galapago	Pittsburgh	4830 McKnight Road
	Buffalo	278 Johnson St.	Detroit	8319 Mack Ave.	San Francisco	714 Harrison St.
	Chicago	1528 West Adams St.	Los Angeles	412 Seaton St.	Seattle	4130 First Ave., S. W.
SALES OFFICES	Baltimore	11 W. 25th St.	Columbus	2700 E. Main St.	Minneapolis	826 Andrus Bldg.
	Cincinnati	49 Central Ave.	Kansas City, Mo.	616 W. 26th St.	New York	600 W. 181st St.

Here are the facts about Triangle's *Hot-*

Triangle Hot-Dip Galvanized Rigid Steel Conduit is produced from choice sections of the highest grade ingots. This insures a perfect base for proper bonding of the zinc. Every length is thoroughly scoured and pickled in acid, leaving the pipe perfectly clean before the application of the protective zinc coating.

When perfectly clean, the conduit is immersed in a bath of molten zinc, coating the *interior* as well as the exterior with a solid, unbroken layer of virgin zinc (99.9% pure). The hot-dip process results in an alloying action that bonds the heavy, pure zinc coating to the pipe. As added protection against corrosion, the conduit is submerged in special formula lacquer, then baked, giving the conduit a smooth, even finish.

Conforms to Federal Spec.
WWC-581b (Galvanized)



Combination of galvanizing and lacquer makes the inside smooth, uniform and well protected.

EVERY LENGTH OF CONDUIT IS IMMERSED IN A BATH OF MOLTEN ZINC — 99.9% PURE

INSIDE AND OUTSIDE

Every square inch of the conduit — inside and outside — is thoroughly and uniformly coated with pure zinc. Remember, because of condensation, the inside of conduit is just as subject to corrosion as the outside. That's why it's important to specify Triangle Conduit — protected inside and outside.

HOT-DIP GALVANIZING IS UNIFORM *NOT TOO THIN-*

Coatings that are too thin in even one spot, are likely to develop tiny pin-point holes through which corrosion can creep. There is no possibility of thin spots in zinc applied by the Triangle hot-dip galvanizing method. The thickness of the zinc coating is uniform — *exactly* the same from one end to the other. Hot-dip galvanized coating is two or three times as thick as other coatings.

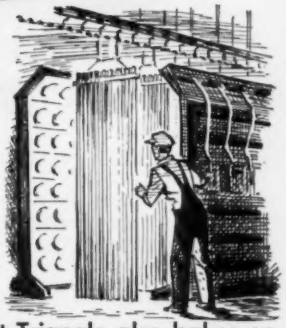
Dip Galvanized Conduit.

NOT TOO THICK-

If the coating on conduit is too thick, it is subject to cracking and flaking when being bent. Careful controls keep the coating of Triangle Conduit at just the *right* thickness — always.

Never too thick — never too thin.

AND AN EXTRA BONUS!



A clear lacquer is applied and baked on the conduit. Not only does Triangle apply the best protective coating (molten zinc) but Triangle also bakes on an additional transparent lacquer of special formula. The application of this baked-on coating insures a permanently smooth interior (for easy pulling) and also provides additional protection against rust or corrosion. It also protects the conduit during shipment.

TRIANGLE CONDUIT is Hot-Dip Galvanized—

and TRIANGLE'S Hot-Dip Galvanizing has never been surpassed!

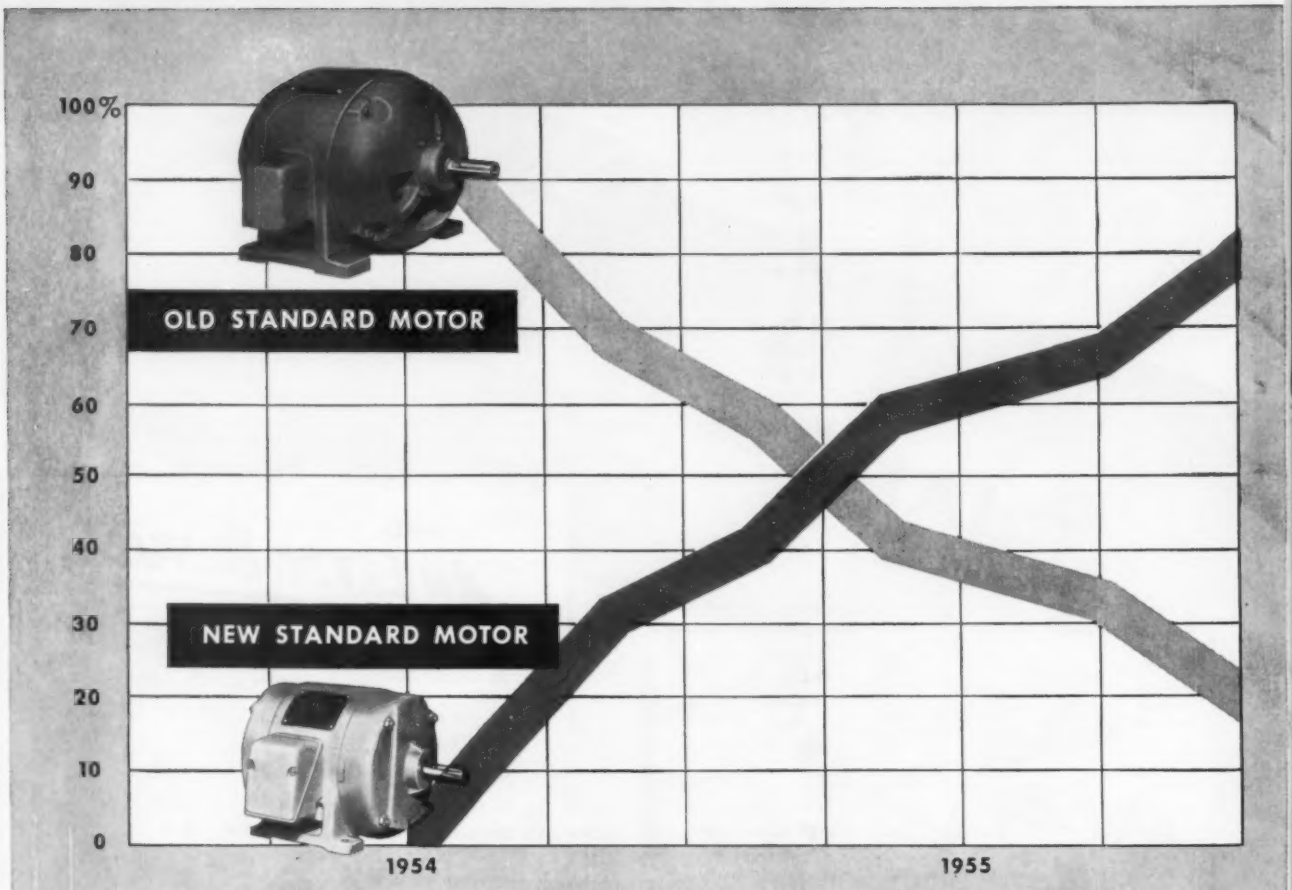
TRIANGLE CONDUIT & CABLE CO., INC. New Brunswick, N. J.

Manufacturers of Arteries for Electricity, Liquids and Gases

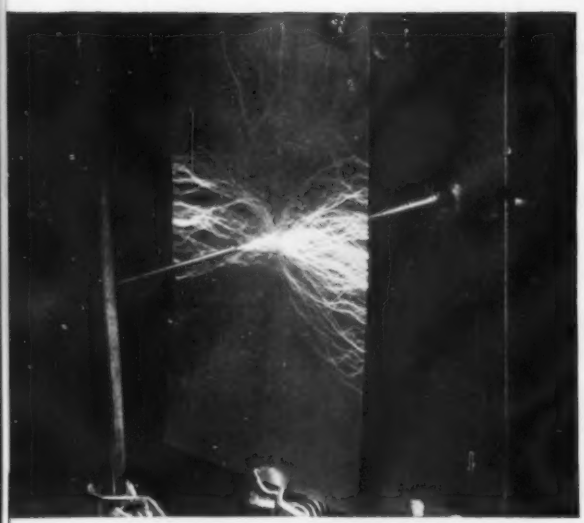
WIRE • CABLE • CONDUIT • PLASTIC PIPE • BRASS AND COPPER TUBE

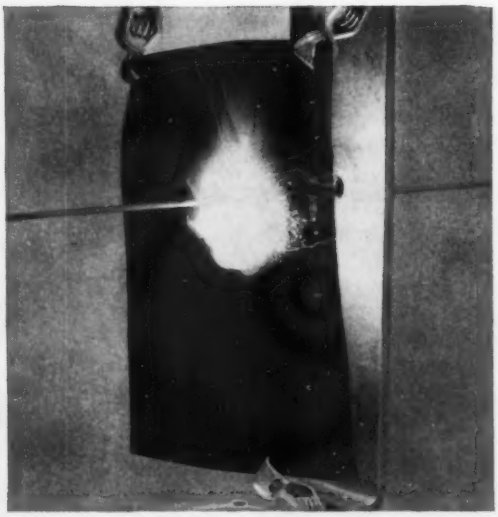
Plants—New Brunswick, N. J.: Wire and Cable Plant, Rod Mill, Brass and Copper Tube Mill, Plastic Pipe Plant. Moundsville, W. Va.: Conduit Plant.

"It MUST Be Right!"



G-E SALES FIGURES SHOW THAT MOST CUSTOMERS HAVE STARTED CONVERSION BY SPECIFYING THE NEW STANDARD MOTORS FOR REPLACEMENT AND ON NEW EQUIPMENT.





NEW "MIRACLE" INSULATION, polyester film, is shown at left withstanding a tremendous high voltage blast. The insulation used in most ordinary motors (right) burned out at about one-third that amount of voltage. Tests like this one show why the new G-E Tri-Clad '55' lasts longer than ordinary motors.

Progress Is Our Most Important Product

GENERAL ELECTRIC

50% MORE POWER for their new centerless grinder was realized by the Van Norman Co., Springfield, Mass., when they switched to G.E.'s new motor. The new 7½-hp motor fitted in the space formerly occupied by a 5-hp motor.

ARE YOU TAKING ADVANTAGE OF THE BIG 'MOTOR SWITCHOVER?'

Brand-new standards for 1 to 30-hp motors, proposed by motor manufacturers (NEMA) in 1953, have already been accepted by more than 75% of American industry.

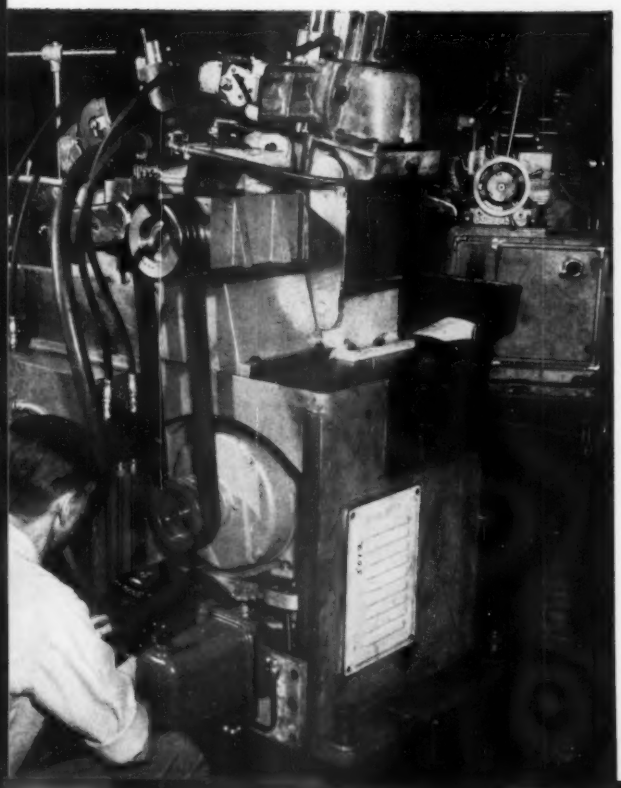
The major factor behind this rapid switchover is that motor buyers are now taking advantage of the longer life, lower maintenance, and better performance afforded by the new motors. Machine performance can be improved with the new G-E Tri-Clad* '55' motor, because of its higher full-load operating speeds.

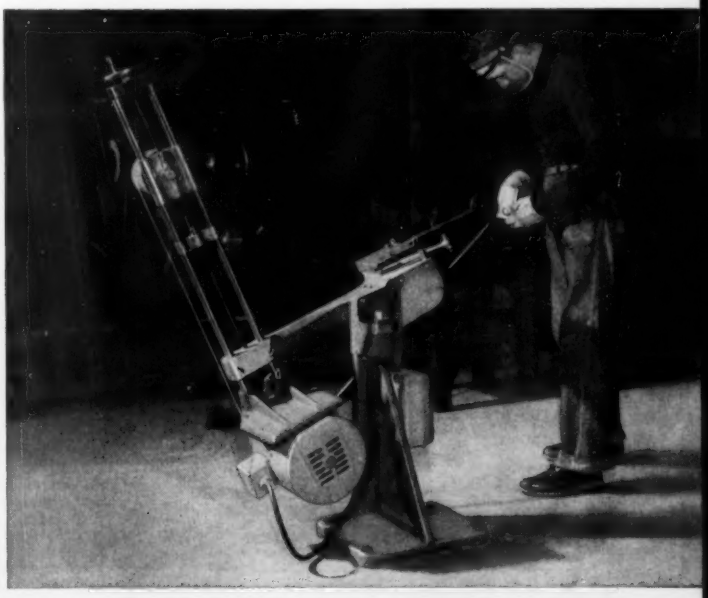
Users are also getting longer life out of the new G-E motors, because of the new insulation which is 8 times stronger than ordinary motor insulation. Maintenance has been greatly reduced through the use of a new synthesized grease with 4 times greater lasting power, and permanumbered leads which can be identified even when taped or clipped.

Are you investing in motor progress or motor obsolescence? You can take advantage of all these latest improvements if you specify G.E.'s new Tri-Clad '55' motor. Contact your G-E Apparatus Sales Office or authorized G-E motor supplier today. *General Electric Co., Schenectady 5, New York.* 648-28

*Reg. trademark, General Electric Co.

"BEST PERFORMING MOTOR that G.E. ever built," says W. J. Conery, chief design engineer of F. E. Myers & Bro. Co., Ashland, Ohio, about the new G-E Tri-Clad '55' motor. Higher full-load speed, smaller size and weight, and modern appearance permitted Myers to reduce size and improve performance of their Centri-thrift (left) and Ejecto (right) pumps.





"FAR EASIER TO OPERATE because of the new motor frame sizes," reports Stephen Bader & Company, Valley Falls, N. Y., in behalf of their new "Space-Saver" polishing machine. The 22% weight reduction in the 2-hp G-E Tri-Clad '55' motor allowed the machine to be redesigned for easier "one-man" handling. Higher full-load speeds permitted improved performance.

Progress Is Our Most Important Product

GENERAL ELECTRIC

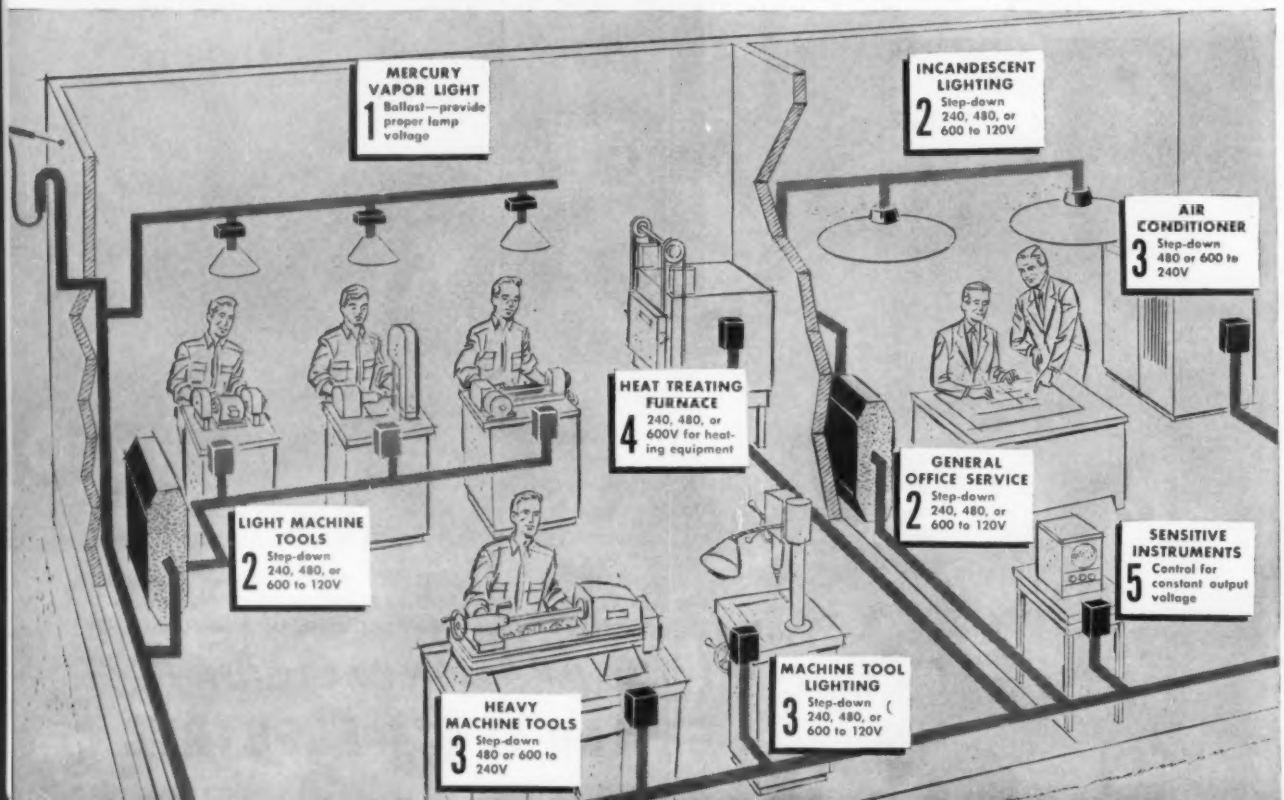
DRY-TYPE TRANSFORMERS

1 **MERCURY LAMP** transformers can be specified for pendant or wall mounting. Roomy junction box behind nameplate makes wiring easy; six-inch leads speed installation.

2 **TYPE D** transformers, for indoor service only, are ideal for general-purpose light and small power service. Available in ratings 25 kva and above.

Here's how five standard General assure you the proper operating

THESE APPLICATIONS of General Electric dry-type transformers are typical of small plant and office installations served at 240, 480, or 600 volts and not requiring load centers. The numbers on the dry-type transformers in this illustration refer to equipment described above.


MERCURY VAPOR LIGHT
1 Ballast—provide proper lamp voltage
INCANDESCENT LIGHTING
2 Step-down 240, 480, or 600 to 120V
AIR CONDITIONER
3 Step-down 480 or 600 to 240V
HEAT TREATING FURNACE
4 240, 480, or 600V for heating equipment
GENERAL OFFICE SERVICE
2 Step-down 240, 480, or 600 to 120V
LIGHT MACHINE TOOLS
2 Step-down 240, 480, or 600 to 120V
SENSITIVE INSTRUMENTS
5 Control for constant output voltage
MACHINE TOOL LIGHTING
3 Step-down 240, 480, or 600 to 120V
HEAVY MACHINE TOOLS
3 Step-down 480 or 600 to 240V

3 **TYPE M** transformers for indoor or outdoor operation are also ideally suited for general-purpose light and power service. Available in all ratings through 15 kva.

4 **SATURABLE REACTORS** provide a very efficient method of controlling voltages to heating equipment and other variable load devices. Available in ratings 3–300 kva.

5 **VOLTAGE STABILIZERS** provide a dependable source of constant output voltage. Available in ratings 0.15 to 5 kva.

Electric dry-type transformers can voltage you want, where you want it

Dry-types in stock now will meet 90% of your requirements for precise voltage at the right place

G-E dry-type transformers, voltage stabilizers and saturable reactors, can be installed quickly . . . *at the load.* Standard models, ready for delivery, will meet most requirements. And you'll like the attractive price of G-E units!

The illustration at left demonstrates a few applications of G-E dry-types that are common in building modernization, expansion, and new construction where service is at 240, 480, or 600 volts.

Most electrical equipment for industrial or commercial use is not built to operate at distribution voltages. With dependable G-E dry-type transformers, you can obtain peak utilization of this equipment. G-E dry-types conserve power and copper feeders, and give accurate control because they can be installed at the load.

Standard units will fill your needs in most cases. In those instances where you need a special unit, we can modify a standard transformer, or build a custom-designed unit for you.

When you need assistance in voltage transformation or control, call your nearest G-E Distributor or Apparatus Sales Office. Or if you want prices and specifications on the standard units described above, complete the coupon and we'll promptly send the information. General Electric Company, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

MAKE GENERAL ELECTRIC YOUR SOURCE OF SUPPLY FOR ALL DRY-TYPE TRANSFORMERS

General Electric Company
Section A410-8
Schenectady 5, New York

Please send me the following bulletins:

- ☐ **LS-103 Mercury Lamp transformers**
- ☐ **GED-2024 M&D transformers**
- ☐ **GEC-976** } **Lighting transformers**
- ☐ **GEC-1208** }
- ☐ **GEC-1207 Distribution transformers**
- ☐ **GEC-1296 Saturable reactors**
- ☐ **GEA-5754 Voltage stabilizers**

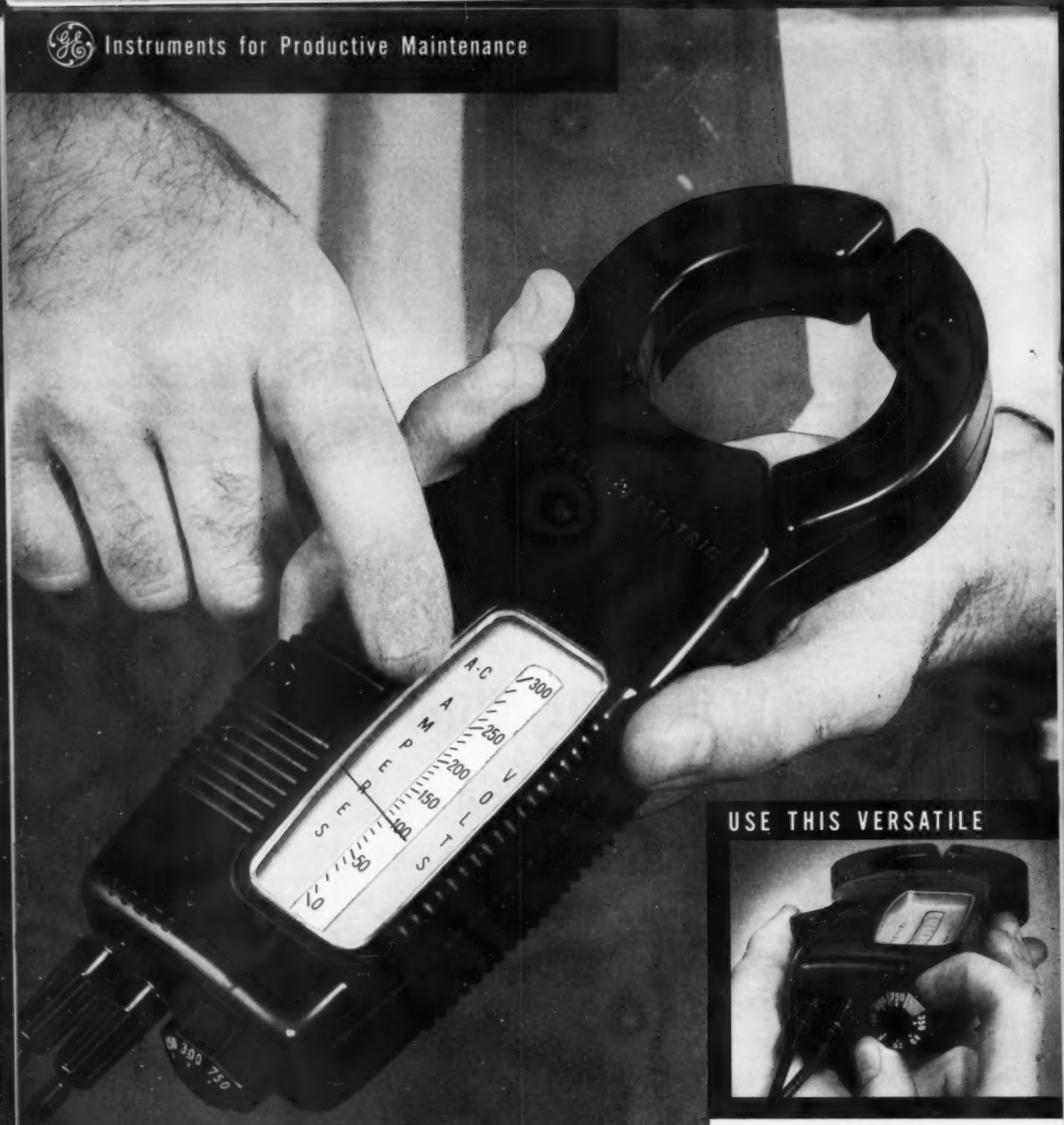
Name .....

Company .....

Address .....

City ..... **State** .....

Instruments for Productive Maintenance



USE THIS VERSATILE

SCREW-IN VOLTAGE LEADS give more protection to operator during actual tests. Voltage terminals are recessed into case for further added protection to operator.

ACTUAL SIZE of G-E hook-on instrument shows large, straight scale for easy reading and accurate checking of electrical quantities. You can see how much easier it is to read this single scale than one with multiple markings on a single face. Contact your nearest General Electric Distributor or Apparatus Sales Office for complete details or clip and send coupon at the right.

G-E Hook-on Volt-ammeter Shows One Scale at a Time; Cuts Down Reading Errors

G-E Instrument Features Eight Scale Ranges for Easier, More Accurate Current and Voltage Measurements

General Electric's hook-on volt-ammeter shows only one scale at a time. You simply select the desired range and only the corresponding scale is visible. This eliminates the possibility of reading the wrong scale, as can be done with multiple scale face instruments. The range and scale of this G-E instrument are changed simultaneously by turning the finger-tip control knob. The two models of the instrument are designated types AK-4 and AK-5, and both have current scales marked in black and voltage scales marked in red.

USED BY contractors, electricians, engineers, maintenance and servicemen, the G-E hook-on is ideal for balancing circuits, tracing faults and grounds, or diagnosing operating troubles . . . without shutting down equipment.

WIDE RANGES are available in both models of the G-E volt-ammeter. Ranges of the AK-4 model are 0–10/30/100/300/800 amperes and 0–150/300/750 volts. The AK-5 ranges are 0–5/20/80/350 amperes and 0–150/300/750 volts. In addition to the wider range on the AK-4 model, you also have a pointer-stop to check surge readings.

G-E HOOK-ON TO CUT MAINTENANCE TIME AND COSTS

SECTION B582-6
GENERAL ELECTRIC COMPANY
SCHENECTADY 5, NEW YORK

Please send me a copy of the bulletin(s) checked below:

- ☐ GEA-6292 AK Hook-on Volt-ammeters
- ☐ GEA-5469 Buyer's Guide for Testing Instruments

Name_____

Company_____

Street_____

City_____ Zone___ State_____

HOOK IS EASILY OPENED by squeezing contoured trigger. Insulation covering reduces possibility of grounding or short circuiting, giving added safety to operator.

LOW PRICE, $66.74* for AK-4, $53.73* for AK-5, includes leather case and 3½-foot screw-in leads. Shock-resistant design helps protect instrument in normal use. Alligator clips hold fast to line.

COMPLETE INFORMATION is available on the G-E hook-on line of testers in the free bulletins offered above. Clip the coupon and mail your request now.

**Manufacturer's suggested resale price.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

In Atlanta -- Youngstown Buckeye Conduit installed in Georgia State Office Buildings

WHY YOUNGSTOWN BUCKEYE CONDUIT IS BETTER

Youngstown is the one manufacturer who makes rigid steel conduit from ore to finished product. This enables Youngstown to control the complete manufacturing process—your insurance that each length of "Buckeye" is made of top-grade steel.

Mechanical Contractors & Engineers, Inc., Electrical Contractor
Electrical Wholesalers, Inc., Electrical Distributors

Youngstown

BUCKEYE QUALITY YOUNGSTOWN SERVICE **CONDUIT**

●Planned and built for years to come, these modern Georgia State Office Buildings have wiring protected by Youngstown Buckeye rigid steel conduit. It was only natural that Buckeye was specified. Made of top-grade steel, Buckeye dependably guards any electrical system against such damaging elements as water, moisture, vapor, dust and dirt. Its durability makes Buckeye rigid steel conduit ideal for wiring systems that must be permanently **safe.**

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices: Youngstown, Ohio - District Sales Offices in Principal Cities

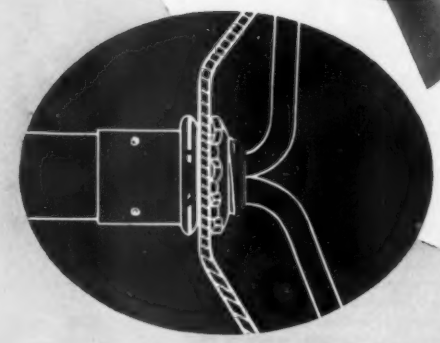
SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - BAR SHAPES - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - RAILROAD TRACK SPIKES

Red Throat

B-M 21 B, THE NEW INSULATED THROAT INDENTER CONNECTOR FOR E. M. T.

Four Ways Finer

1. Protruding rounded red plastic lip of bushing prevents cutting of insulation — eliminates shorts.
2. Full thread screws into all conduit fittings. Lip of RED THROAT bushing protects thread from damage.
3. Deep dished eight pronged lock nut is easier to drive on — screws flush to shoulder and digs into metal of box for vibration proof positive ground.
4. Permanent locked-in bushing insures smooth burr-free raceway for easy fishing. No extra work and costs no more.



Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job!

ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT

Order from Your Wholesaler!

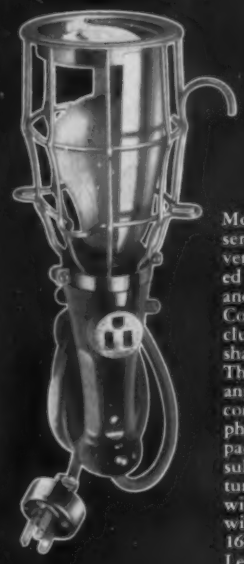
All B-M Indenter Fittings are U.L. Approved as concrete-tight and for general use (File Card E10863). Also comply With Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

Warehouse Stocks in Principal Cities for Immediate Delivery!

the grounded portable lighting

for modern plants



McGill 5000 series grounded service lights feature the convenience outlet and plug adopted as standard by Underwriters' and the National Electrical Code. Blade arrangement includes parallel blades and U shaped third blade for ground. This heavy duty portable and any attached power tools are completely grounded. Molded phenolic handle is heat and impact resistant and positively insulated. Heavy wire cage featuring end lens is zinc plated with chromate finish. Available with or without black rubber 16-3-SJ cord and Levolier Switch.

McGILL 5025-SLRG

McGILL® *lamp guards*

STAND THE WEAR AND ABUSE OF HEAVY USE

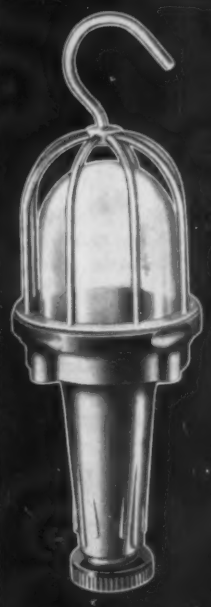
The most popular all purpose portable lamp guard ever produced, the McGill 7000 series, has extra heavy steel wires electrically welded with a chromate finish over a heavy zinc plate. Pliable molded rubber handles provide cord seal and strain relief disk. Lampholders are 660 watt 250 volt either plain or waterproof. No-Rol feature. Available with or without Levolier switch and 18-2-SJT black rubber cord. Will last many times longer than ordinary portable in all heavy duty industrial applications.

McGILL 7000-SR

all are McGILL *quality*

water-tight vapor-tight and moisture proof

portable lighting



These 3000 series McGill Vaporproof portables are used extensively in flour mills, elevators, ships, food processing plants and warehouses to eliminate hazards of shock, glass splinters and sparks from broken bulbs. A heat and impact resistant globe seals against the molded phenolic handle to guard the bulb from splashing liquids. The best in protective portable lighting available in 60 or 100 watt bulb size with either metal or fibre cages.

McGILL 3006

NEW portable

for spot or flood lamps

Designed in two sizes for 75 or 150 watt spot or flood lamps this new series offers an especially durable portable that throws light into ordinarily inaccessable places. Cages available for both PAR-38 or R-30-75 lamps on a pliable rubber handle, are standard with or without Levolier switch. The newest thing in dependable portable lighting. Underwriters' approved as are all McGill Portable Lamp Guards.

McGILL 7000-30

50th McGILL Anniversary

YOU CAN DEPEND ON

McGILL QUALITY

Available through leading Electrical Wholesalers

For complete information on products of the McGill Electrical Division, write today for Catalog No. 49-A.

McGILL MANUFACTURING COMPANY, INC.
450 N. Campbell St., Valparaiso, Indiana

This G-E development engineer is testing a ballast design for a new fluorescent application. He's a member of the largest ballast development group in the industry. The fundamental research which they perform is one important reason why G.E. is the leading supplier of fluorescent ballasts.

Flora* shows you how . . .

General Electric Ballast Design Leadership Helps You Save Lighting Dollars

General Electric's design leadership has contributed greatly to the vast fund of knowledge now available and being used by the entire ballast industry.

A recognized pioneer in ballast design, G.E. has led in these important developments: Tulamp lead-lag, certified series 96T12, trigger start, rapid start, clamped core, plastic sign, and dimming ballasts. G.E. emphasizes product leadership to provide the best ballast value to the user. We have never resorted to the temptation of lowering product quality to gain competitive advantage. Instead, we furnish only the best ballasts to assure economical fluorescent lighting. We're convinced there is no substitute for satisfactory performance.

To be sure of top quality ballasts with the latest design developments, look to the leader . . . General Electric!

The next time you specify equipment for a fluorescent lighting installation, make sure you get the best . . . specify General Electric ballasts.

A G-E ballast tag or sticker on your fixture is proof that it's equipped with the best in ballast value. It's the only way to be certain. For further information on G-E ballasts, write Section 401-15, General Electric Co., Schenectady 5, New York.

*Miss Fluorescent Ballast, G. E.'s Ballast Mascot

Copyright 1955, General Electric Company

USER SATISFACTION gets foremost consideration by G-E ballast development engineers. Here a ballast is being checked to make sure it will provide optimum light output and lamp life.

Five more reasons why

GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

- EXCLUSIVE SOUND RATING SYSTEM
- SUPERIOR QUALITY CONTROL
- LONGER BALLAST LIFE
- PRECISE LAMP-MATCHED DESIGN
- COMPLETE CUSTOMER SERVICES

Progress Is Our Most Important Product

GENERAL ELECTRIC

ALL NEW!

No. 9755
New Cord Grip New "Fiberite Face"

No. 5294
New Cord Grip New "Fiberite Face"

No. 5694
New Cord Grip New "Fiberite Face"

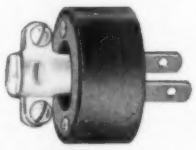
3 New Bryant Cord Connector Bodies Take Full Range of Wire Sizes (.296 to .625 in.)

For use in industrial plants, steel mills, shipyards, garages — wherever there's rugged usage.

These all-new Bryant molded rubber cord connector bodies for the first time permit using the wide range of wire sizes needed in heavy-duty installations. Built to "take it", this new line should be used with the companion caps shown at right.

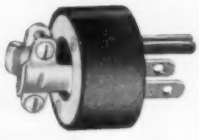
Listed by Underwriters' Laboratories, Inc.

Use New Cord Connector Bodies With These Bryant Caps



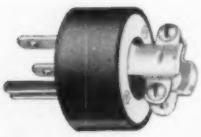
CONNECTOR No. 9755

fits Caps	Cord Grip
No. 9754	.296 to .562
No. 9756	.406 to .625



CONNECTOR No. 5294

fits Caps	Cord Grip
No. 5266	.296 to .562
No. 5267	.406 to .625



CONNECTOR No. 5694

fits Caps	Cord Grip
No. 5666	.296 to .562
No. 5667	.406 to .625

Specify Bryant from your Electrical Distributor

THE BRYANT ELECTRIC COMPANY
Bridgeport 2, Connecticut
Chicago • Los Angeles

BRYANT
SUPERIOR WIRING DEVICES

J-9992B A

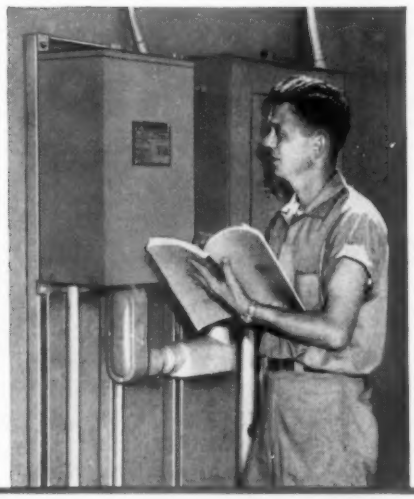
LOOK!

A Dry-Type Transformer with Class H Insulation

(150 C Rise)

Here's a completely new line of totally enclosed dry-type transformers with Class H insulation. Maintenance is completely eliminated. Dust and dirt are kept out. No more worrying about the effect of lint or moisture in the atmosphere. You can use them indoors or outdoors — they are completely weatherproof. And the compact Allis-Chalmers design gives you lower weights, reduced dimensions. In many cases installation will be less costly, easier.

All these advantages at little or no extra cost!



Best of all, there is no increase in cost in ratings 10 kva and below, single phase, and 30 kva and below, three phase. A slight increase in cost of higher ratings is more than offset by the many new advantages.

The tank is simple and sturdy — it has four formed corners and only one welded seam. The bottom plate is recessed and held to the case by bolts for quick removal. The coil is given maximum protection with expensive Class H insulating materials. The unit is designed for 150 C rise. The result is a convenient, compact transformer that will give years of satisfactory operating life.

For more information call your nearby Allis-Chalmers distributor or district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4529

ALLIS-CHALMERS

"Naturally, I'm figuring on Day-Brite —I've found it pays"

James W. Potter, Potter Electric Service, Urbana, Illinois

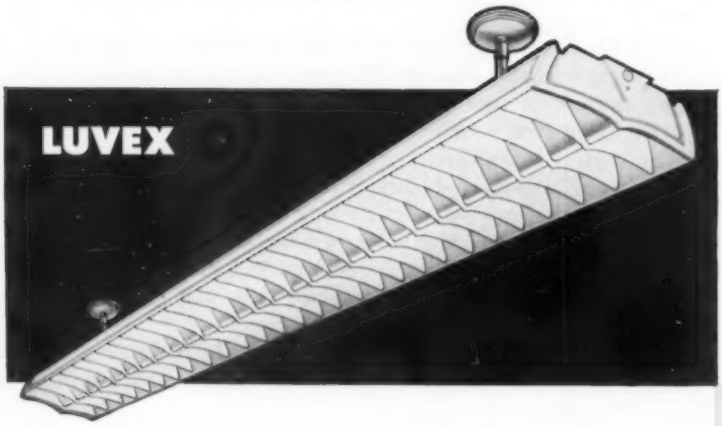
"I'll tell you why I am so strong for Day-Brite fixtures:

"In the first place, Day-Brite makes an out-and-out quality product. All the time. And that counts for a lot, because when I install Day-Brite fixtures I can count on customers who are completely satisfied. That leads to more business for me—you know, nothing beats a satisfied customer.

"On the job, Day-Brite fixtures are a cinch to install. Because they're so easy to hang and line up, I save a lot of time. And, as the old saying goes—'Time is money.'

"Another thing: Day-Brite deliveries are OK. The fixtures arrive in good shape—they're complete with all fittings and fasteners. Shipping cartons are coated on the inside with a special wax film to protect the fixture finish against abrasion and damage. I can always be sure of a 'factory-fresh' fixture.

"There are a lot of other things about Day-Brite fixtures that make them preferred, not only by contractors, but by architects and owners, too. Ask your Day-Brite representative to tell you more."



Attention to detail makes Day-Brite Fixtures "decidedly better." For instance, note the overall rigidity of LUVEX® fixtures. They maintain alignment even in areas near shop work where vibration is present.

SEE!

EXAMINE!

COMPARE!

Day-Brite Lighting, Inc., 5402 Bulwer Ave., St. Louis 7, Missouri. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

"DECIDEDLY BETTER"
DAY-BRITE
Lighting Fixtures

5447

see your Day-Brite distributor

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

Like Easy Fishing?

GET NE Sherarduct

RIGID STEEL CONDUIT

Easy fishing . . . that's one reason contractors like Sherarduct rigid steel conduit. In addition to a smooth inside surface, Sherarduct's accurately cut threads let conduit ends butt inside the coupling . . . eliminate gaps that interfere with easy fishing.

Sherarduct has other plus features as well: The Sherardizing process of galvanizing that alloys zinc with the conduit wall, (plus a baked-on Sher-enamel coating) fortifies Sherarduct against rust and corrosion for life. All surfaces, including the hill and valley of every thread, are securely protected against corrosion.

Finally, the gradual heating and cooling of the Sherardizing process normalizes the metal in an annealing like process. Result: easier working, forming and bending on the job.

Write for a free copy of our new Sherarduct facts book. You'll see why the Sherardizing principle makes Sherarduct "galvanized conduit at its best."

Listed by Underwriters' Laboratories, Inc.

LIFE-TIME CORROSION PROTECTION
•
EASY FISHING
•
ZINC PROTECTED THREADS
•
STRONG COUPLINGS
•
THOROUGH GROUNDING
•
EASY BENDING

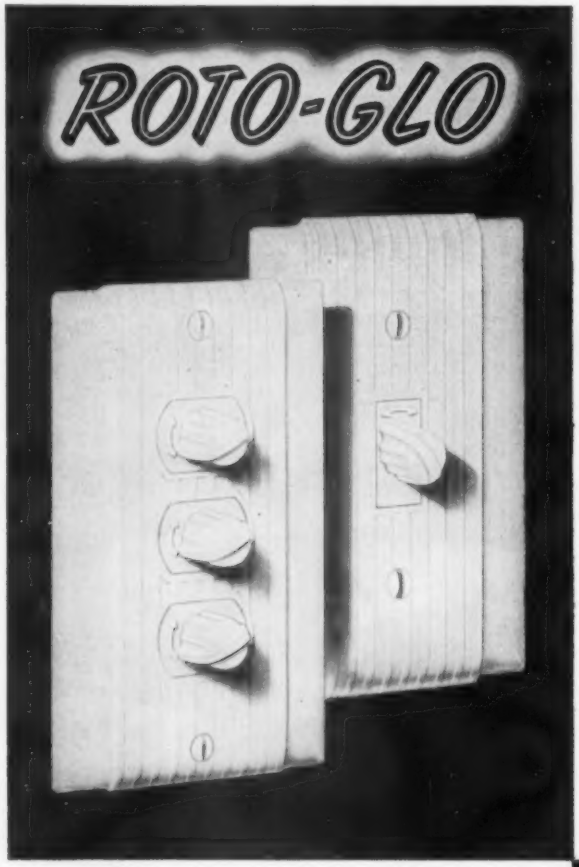
Sherardizing is galvanizing at its best . . . Sherarduct is galvanized conduit at its best

NATIONAL ELECTRIC PRODUCTS CORP. PITTSBURGH, PA. 50TH ANNIVERSARY 1905–1955

National Electric Products

PITTSBURGH, PA.

3 Plants • 10 Warehouses • 36 Sales Offices



another first by P&S®

. . . because switches should be SEEN . . . not heard

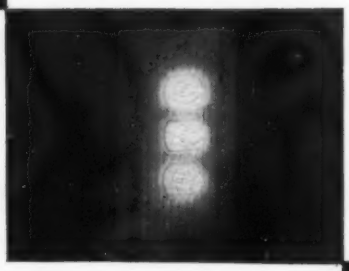
Available in P&S Despard type for combination wiring, or conventional strap type. P&S Despard type Roto-Glo switches are rated 15 A., 120 V., A.C., 277 V., A.C.; strap type, rated 15 A., 120 V., A.C.

P&S Roto-Glo switches can be used to *full current rating on fluorescent* and incandescent lamp loads — and on motors where full load current is not more than 80% of rating of switch.

For the complete ROTO-GLO Trade Mark story, write to Dept. M

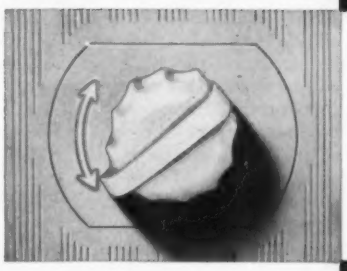
PASS & SEYMOUR, Inc.
Syracuse 9, New York

71 Murray St., New York 7, N. Y.
1229 W. Washington Blvd., Chicago 7, Ill.



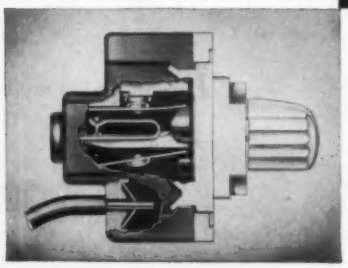
it's a LUMINOUS switch

A moment's exposure to any light source and the Roto-Glo knob will pin-point switch location all night long.



it's a ROTO switch

You turn Roto-Glo switches on just like a radio or television. The classic knob tells you it is a quiet switch at a glance.



it's a QUIET switch

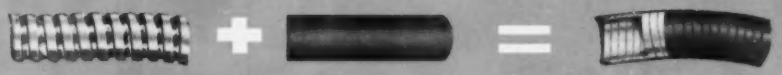
Entirely new mechanism prevents vibration and noise — can be installed in any position. Screwless terminals for quick, easy wiring.

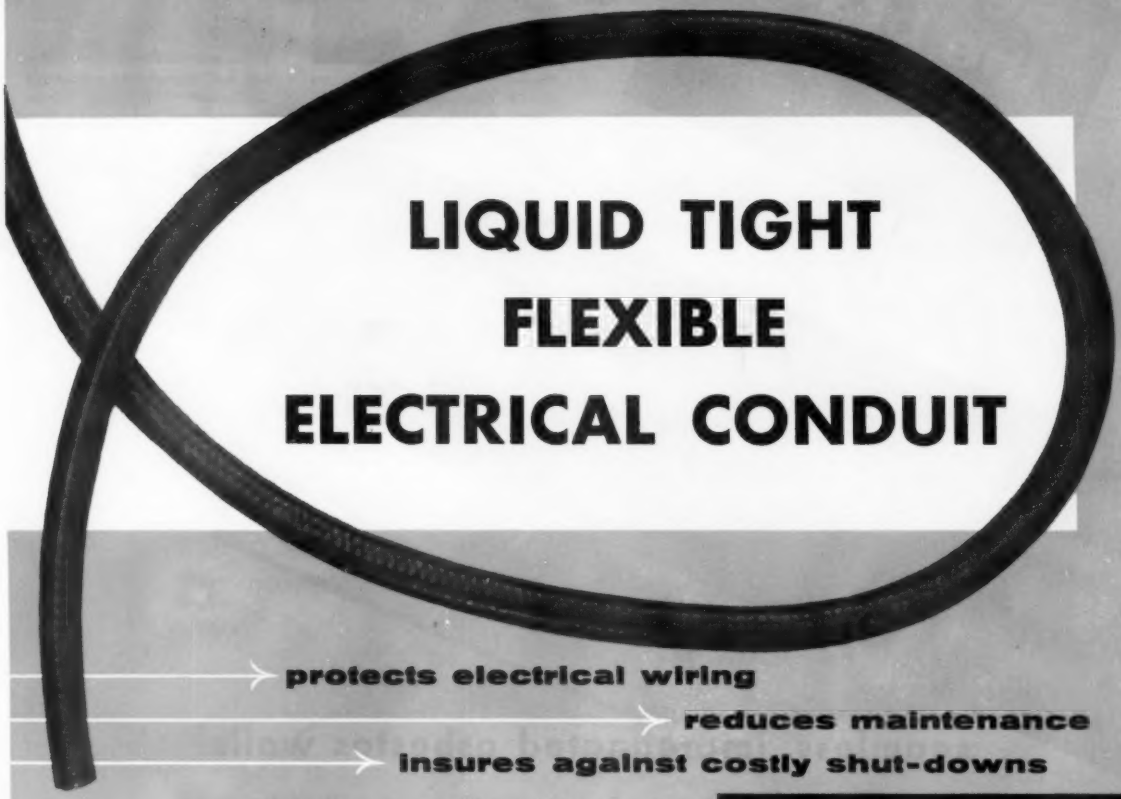
NEW

COLUMBIA

FLEX-SEAL

GALVANIZED STEEL + VINYL = UNIQUE WIRING PROTECTION





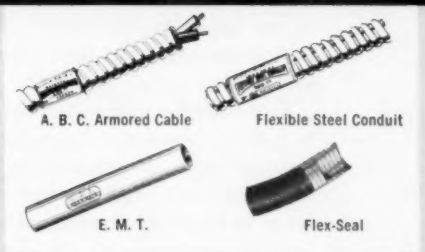
LIQUID TIGHT FLEXIBLE ELECTRICAL CONDUIT

protects electrical wiring

reduces maintenance

insures against costly shut-downs

Manufacturers of Steel Electrical Conduit Since 1912



FLEX-SEAL is ideal for use in chemical plants, food processing plants, laundries, machine shops, and every industrial location where moisture, oils, coolants, chemicals, and corrosive fumes attack ordinary conduit and create hazardous wiring conditions. It can be used indoors and outdoors. FLEX-SEAL bends to small diameters, facilitates work in tight spaces. Sizes ⅜" to 2". Connections made with standard fittings.

J. I. C. Approved

WRITE FOR BROCHURE & SAMPLE

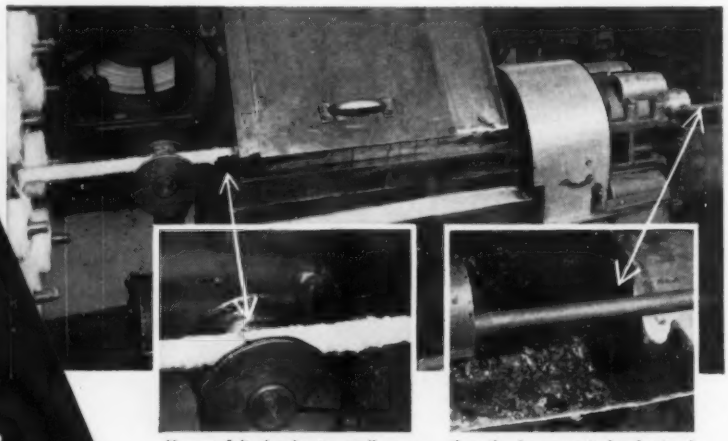
COLUMBIA CABLE & ELECTRIC CORP.

Serving the Electrical Wholesaler Since 1912

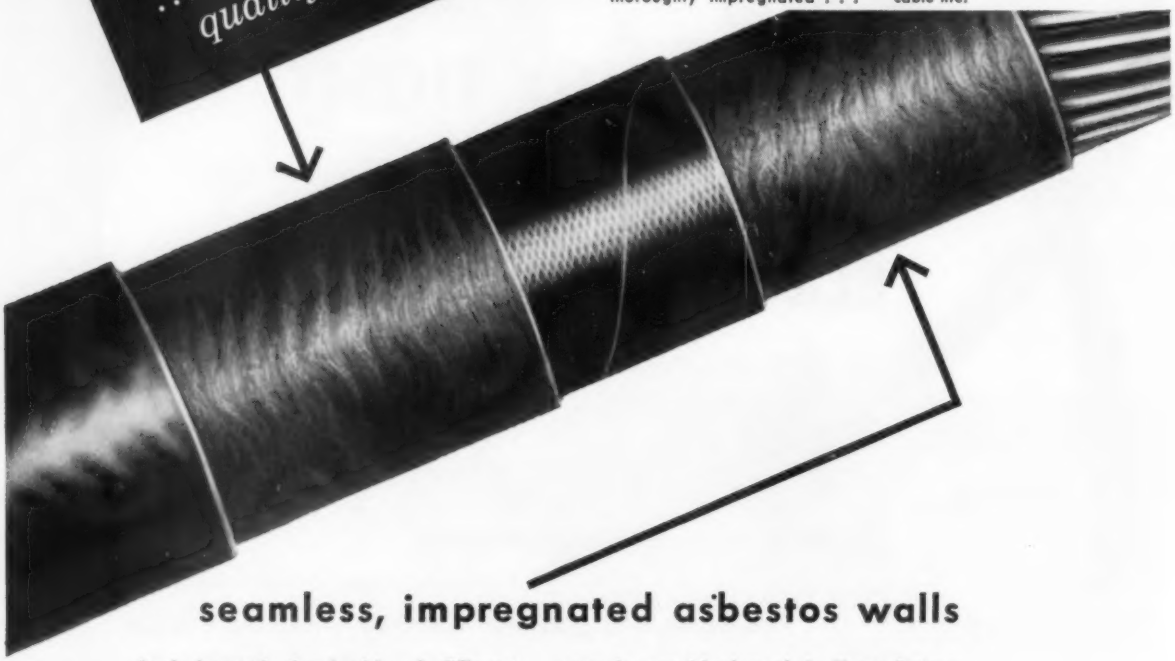
255 Chestnut Street Brooklyn 8, New York

look beneath the braid

...that's where quality begins



Heavy, felted asbestos walls are applied over and under the varnished cambric tapes . . . then thoroughly impregnated . . . then the impregnated asbestos is compressed to a dense, homogeneous wall that ensures long cable life.



seamless, impregnated asbestos walls

Look beneath the braids of different kinds of N.E.C. Type AVA wire or cable. For the longer life that means real economy, look for the seamless, felted asbestos walls of *Rockbestos A.V.C.* Type AVA.

Each asbestos wall in *Rockbestos A.V.C.* is a dense, non-porous, *permanently* heat-resistant wall . . . a homogeneous "seamless tube" made of long, silky asbestos fibers felted to form a continuous wall under and over the varnished cambric. Heat dissipation is uniform. Dielectric strength is high and stays high. The seamless construction gives added strength against bending stresses.

Get the complete story on the construction and test specifications of *Rockbestos A.V.C.* Type AVA in the new booklet: "Specification RSS-88". Write for your copy now.

STOCKED COAST TO COAST
Standard Rockbestos A.V.C. construction (N.E.C. types AVA, AVB, etc.) are available for immediate shipment. Call or write nearest branch office.

ROCKBESTOS PRODUCTS CORP.
NEW HAVEN 4, CONNECTICUT

NEW YORK • CLEVELAND • DETROIT • CHICAGO • PITTSBURGH • ST. LOUIS • LOS ANGELES • NEW ORLEANS • OAKLAND, CALIFORNIA •

ANOTHER EXAMPLE OF Cope EFFICIENCY...

COPE 70,000 SERIES CABLE TROUGH WITH THE BUILT-IN COUPLER

now available in 12′ length

33% fewer connections

The new Cope 70,000 Series Cable Trough with the built-in Coupler is now available in 8, 10, and 12 *foot lengths,* and affords you 80% SAVINGS in assembly time, PLUS 33% FEWER CONNECTIONS.

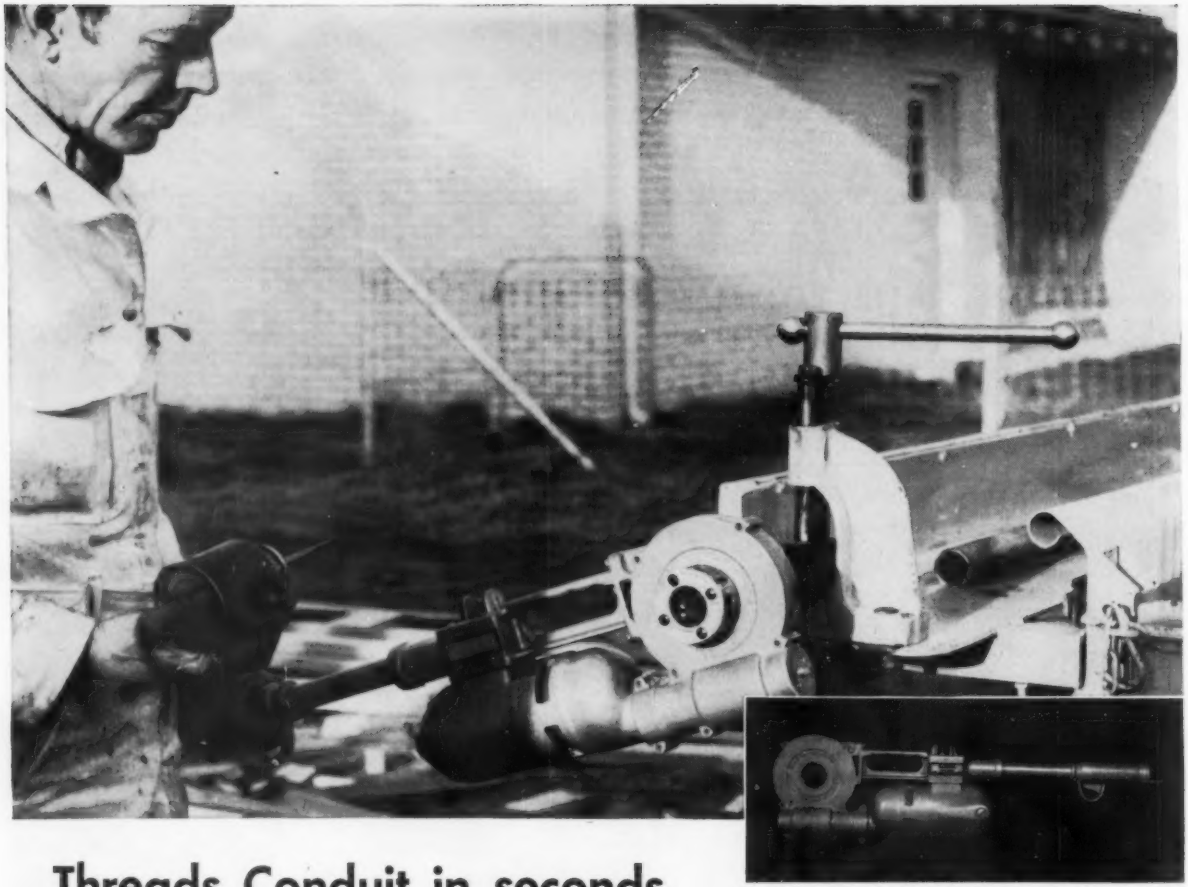
These features alone mean real savings for you, in time and money.

*PATENT PENDING

Cope

T. J. COPE, INC.

711 SOUTH 50th ST., PHILADELPHIA 43, PA.



Threads Conduit in seconds

...the Lawco, Jr.

PORTABLE PIPE THREADER

Here's the answer to those slow, tiring, hand-threading jobs. The Lawco, Jr. Portable Pipe Threader does the work in seconds. This modern portable power tool threads the smallest to the largest conduit. Simple adapters and speed reducers handle pipe from ¼-inch to 10".

Its operation is simple. Just position Lawco, Jr. on the conduit, press the trigger, and the power unit drives the cutting dies. You're finished in no time, and right at the location where you are installing the conduit.

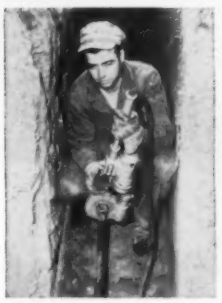
And Lawco, Jr. comes in handy for other jobs, too. Several are illustrated at the right. In addition to these applications, you can use your Lawco, Jr. for driving nuts and bolts, and hoisting weights up to 500 pounds.

This light weight (20 lbs.) tool is precision built for years of service. Write for details.

VELOCITY POWER TOOL CO.

201 North Braddock Avenue, Pittsburgh 8, Pa.

The Lawco, Jr.—portable, versatile, compact. Does a variety of jobs faster, better.

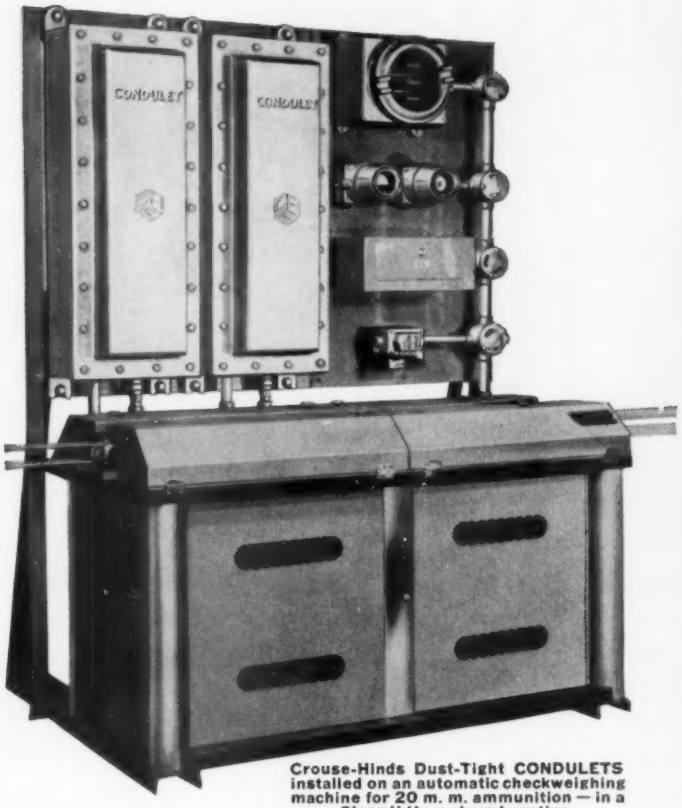


Augering operation with Lawco, Jr. Efficient in vertical or horizontal operations.

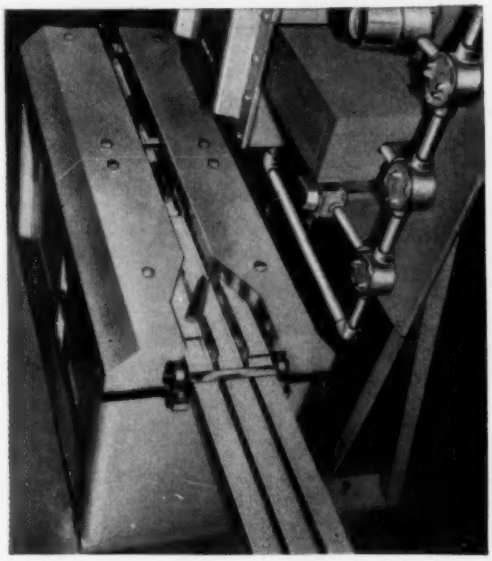
Post hole application using square shank. Lawco, Jr. does it faster.

There's nothing better for pulling wire through conduit than the Lawco, Jr. The unit's portable feature speeds work.

Dust-Tight
CONDULET* electrical installations give you maximum PROTECTION where combustible dusts are present



Crouse-Hinds Dust-Tight CONDULETS installed on an automatic checkweighing machine for 20 m. m. ammunition — in a Class II Hazardous Location.

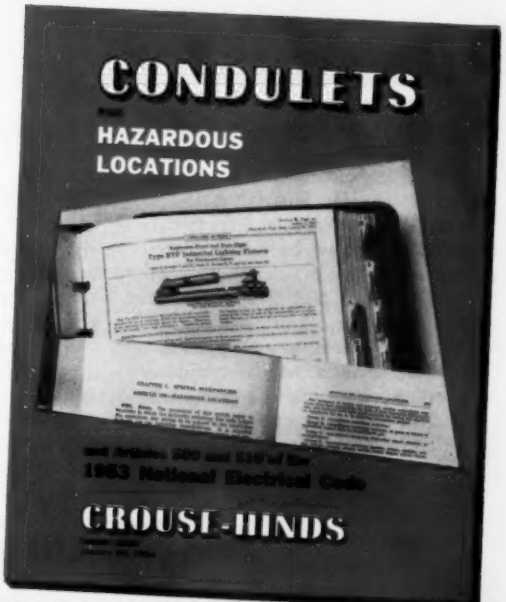


Machines that operate in locations where combustible dust may be present must have electrical installations that meet the requirements of the National Electrical Code. This gives you protection against disastrous explosions and fires and assures uninterrupted service.

For nearly fifty years Crouse-Hinds has manufactured CONDULET electrical equipment of the highest quality, designed to meet Underwriters' Laboratories standards for both ordinary and hazardous locations.

If your machines operate in *any* hazardous location — atmospheres containing flammable gases, vapors, dusts, or flyings — take advantage of Crouse-Hinds offer to send you a FREE copy of Bulletin 2655. It contains a complete copy of the Articles in the National Electrical Code pertaining to hazardous locations, with many useful tables, diagrams, photographs, and suggestions for selecting the correct equipment to meet these Code requirements.

Send for your copy of this valuable reference bulletin today!



*CONDULET is a coined word registered in the U.S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

A Nationwide Distribution Through Electrical Distributors

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Syracuse 1, N.Y.

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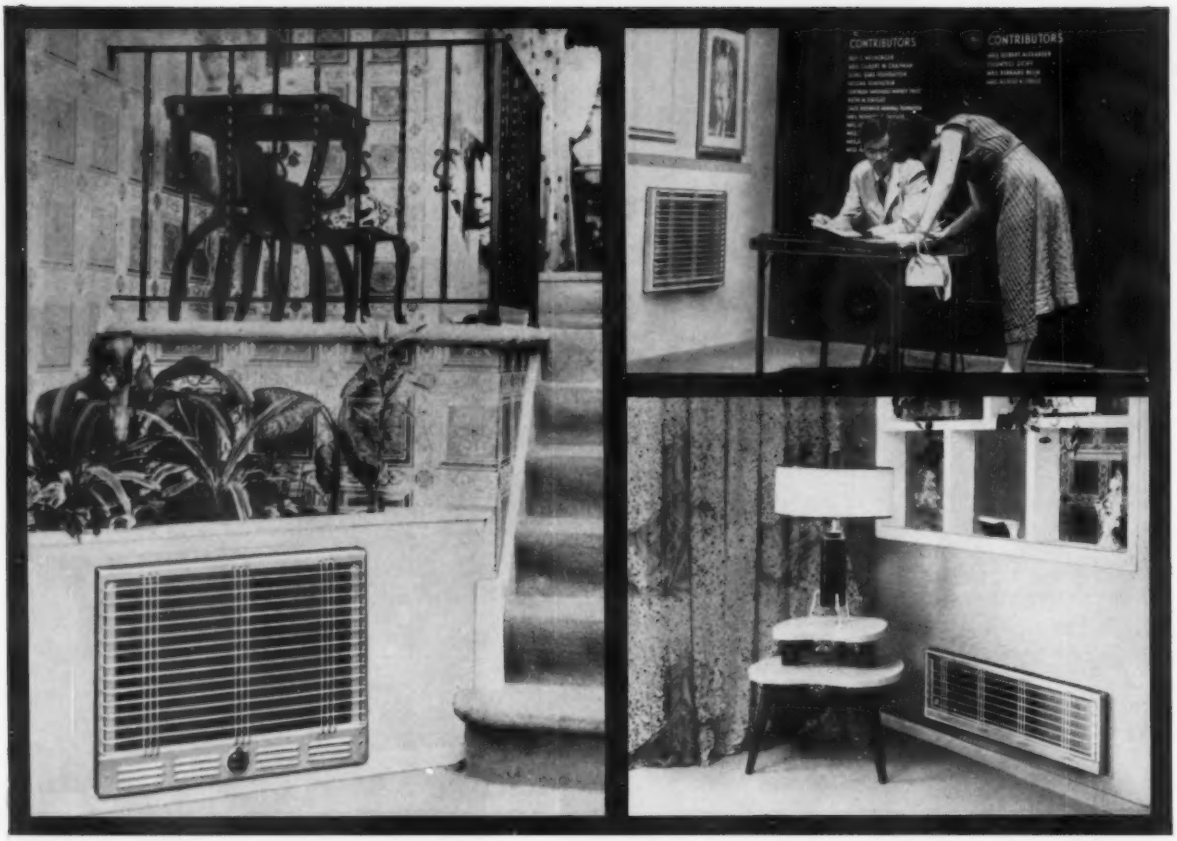
CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS



Installation photographs courtesy of Berko Electric Manufacturing Corp.

You can recommend this radiant heat panel confidently

The wall-mounted heating units illustrated above are made and sold by the Berko Electric Manufacturing Corp., Queens Village, N. Y. Owners of such Berko heaters are enthusiastic about the comfort, convenience and safety they provide.

The heating elements in these heaters are PYREX Radiant Glass Panels. You can expect your customers to have confidence in any heater you may recommend with a PYREX panel heating element, as they are already familiar with other PYREX brand products having excellent heat-resistant qualities.

PYREX Radiant Panels are made of heat-resistive glass with an electrically conductive coating inseparably bonded to the entire back surface. Thin silver strips bonded to opposite edges of the panel distribute the current *evenly* over its entire length and breadth. This provides completely uniform heat radiation.

Efficient

PYREX Radiant Panels radiate about double the heat of a metal-finish radiator at the same operating temperature. This high degree of efficiency helps bring the cost of electric heat within reach of more homeowners. Also, there is little initial surge of current when these panels are turned on—another point of economy.

The coated side of the panel itself acts as a heat reflector. With the addition of a metal reflector, as much as 80% of the input energy is available as heat radiation from the panel's uncoated side.

At 400°F. over 75% of the panel's heat energy is emitted in wave lengths of four microns and longer. This energy provides instant warmth and comfort.

Customer benefits

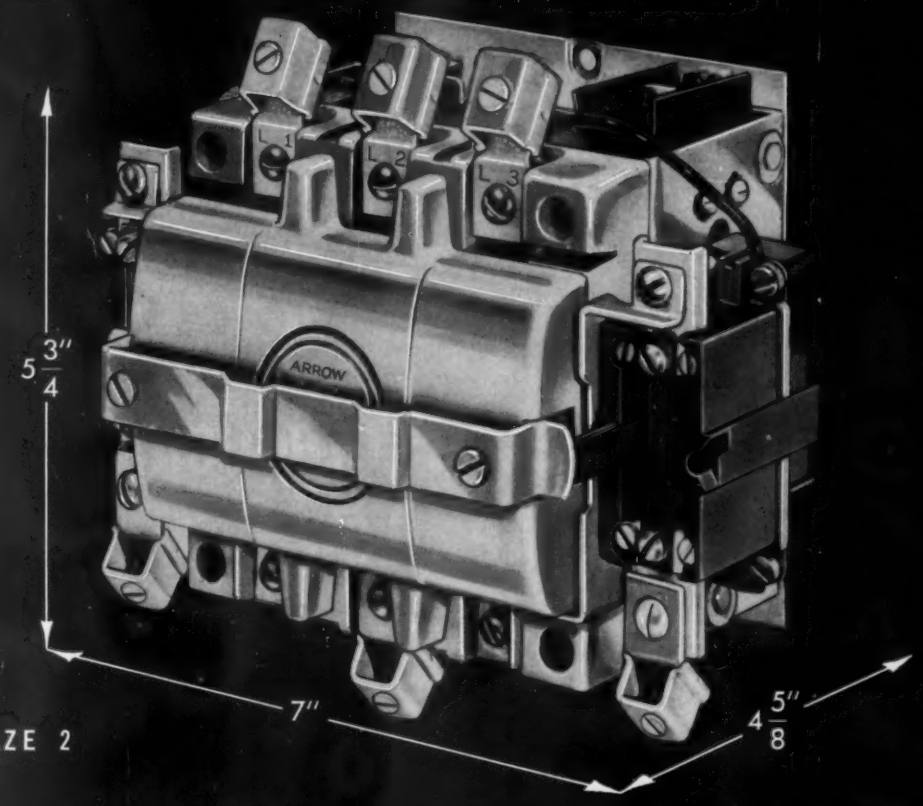
PYREX panels provide clean, draftless heat and the panels themselves are easy to wipe clean. Free dust particles will not adhere to or carbonize on them. In-the-wall installation leaves completely free floor space and installation is easy. There's space saved, too, because there is no heating room. Every room is individually thermostatically controlled. The glass is high in physical strength. It's safe and durable.

For additional technical information on PYREX Radiant Panels, write, wire or phone.

CORNING GLASS WORKS, CORNING, N.Y.
96 Crystal Street
Corning means research in Glass

ARROW AH HART

TYPE "RA" MAGNETIC STARTERS



SMALLER IN SIZE, WEIGHT and OVER-ALL COST

Much smaller and lighter than other starters of comparable rating. Straight-thru front wiring saves in installation time. Easy contact inspection or replacement saves maintenance costs. Type "RA" Magnetic Starters are available in sizes 0 thru 5 in standard and special purpose housings.

Mail coupon for free folder "The Big Story" which gives more detailed information.

ARROW-HART
INDUSTRIAL CONTROL DIVISION
103 HAWTHORN ST., HARTFORD 6, CONN.

OFFICES, SALES ENGINEERS AND WAREHOUSES IN:

ATLANTA	DALLAS	MINNEAPOLIS	SAN FRANCISCO
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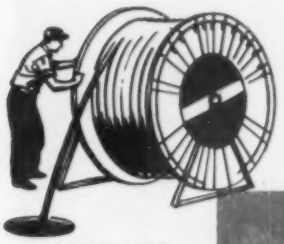
Quality MOTOR CONTROLS • WIRING DEVICES
ENCLOSED SWITCHES • APPLIANCE SWITCHES

ARROW AH HART

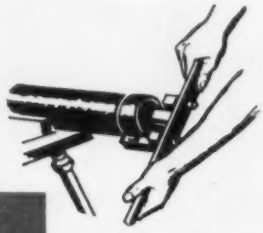
INDUSTRIAL CONTROL DIVISION ECM
THE ARROW-HART & HEGEMAN ELECTRIC CO.
103 HAWTHORN STREET, HARTFORD 6, CONN.
Please send my copy of "The Big Story" which tells why A-H "RA" Magnetic Starters are the logical choice for my plant.

NAME_____
POSITION_____
COMPANY_____
CO. ADDRESS_____
CITY_____ ZONE____ STATE_____



SMOOTH BORE
NO SCORING OR
ABRASION OF SHEATH

EASY TO
INSTALL



EASY TO TOOL

The Happy Combination

CUTS WITH SAW

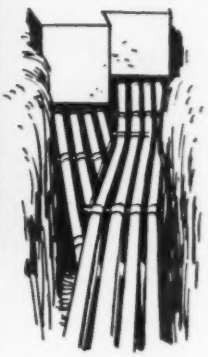
LIGHT - EASY
TO HANDLE

Complete Protection... Long Life...Low Cost

ORANGEBURG
NOCRETE

COMPLETE LINE OF
INTERLOCKING PLASTIC SPACERS

WATER TIGHT JOINTS



ORANGEBURG
STANDARD

HOW does Orangeburg give cables complete protection? It's tough and strong. It's resilient, and "gives" without cracking or breaking. Its walls are impermeable. Its non-metallic material resists acids, alkalies, oil and salt in ground waters. Its joints are watertight. Its smooth bore reduces danger of abrasion.

WHY such low cost? Because Orangeburg is lightweight and easy to install; it lays faster than any other type of conduit... saves time and money. The long 8-foot lengths mean fewer joints to make. The Taper Sleeve Joints seal watertight with a few light taps. It lasts indefinitely... gives years and years of economical service.

Orangeburg is a leader in every city and state. For data about Fittings, Angle Couplings and Bend Sections, write Dept. EC-65.

ORANGEBURG MANUFACTURING CO., INC. • Orangeburg, N. Y. • West Coast Plant, Newark, Calif.

ORANGEBURG® FIBRE CONDUIT

STANDARD INSTALLED WITH CONCRETE

NOCRETE INSTALLED WITHOUT CONCRETE

GraybaR ELECTRIC COMPANY

DISTRIBUTORS, ORANGEBURG FIBRE CONDUIT

BRANCHES AND STOCKS IN PRINCIPAL CITIES

GENERAL ELECTRIC SUPPLY COMPANY

A DIVISION OF GENERAL ELECTRIC DISTRIBUTING CORPORATION

stage lighting controls system

by FA

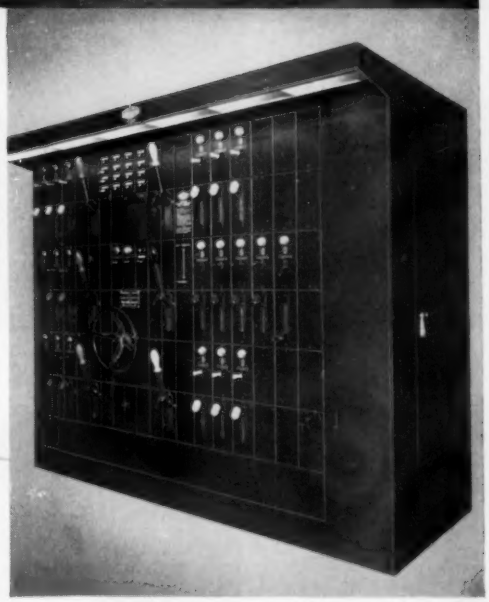
Stage Lighting Control Systems by FA are a popular feature of more than 500 theaters, high school and college auditoriums in this country and elsewhere.

That's because FA Stage Lighting Controls add tremendously to the color, beauty and enjoyment of these structures.

The result of more than 50 years experience and know how, FA Stage Lighting Controls embody the latest features in design and construction.

Built on the unit basis, FA Stage Lighting Controls can be made to fit any type of auditorium or theater. All are approved by the Underwriters' Laboratories, Inc., for label service and will give long lasting and trouble free service.

Include an FA Stage Lighting Control System in all school, college or other auditorium you are called upon to design. For further details contact your nearest FA representative listed in Sweet's.



FA Stage Lighting Control Board installed in Parma, Ohio School.

Illustrative of the wide range of control systems produced by FA are the following:

CONTROL BOARDS for Manual Control, Modified Pre-Set Remote Control, Multiple Pre-Set Remote Control, Motor Driven Control, Electronic Tube Control, Mobile Color Lighting Control.

DIMMING CONTROL EQUIPMENT—
Resistor Type, Auto-Transformer Type, Electronic Reactor Type.

Frank Adam Electric Co.

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BOX 357, MAIN P. O. • ST. LOUIS 3, MO.

makers of:
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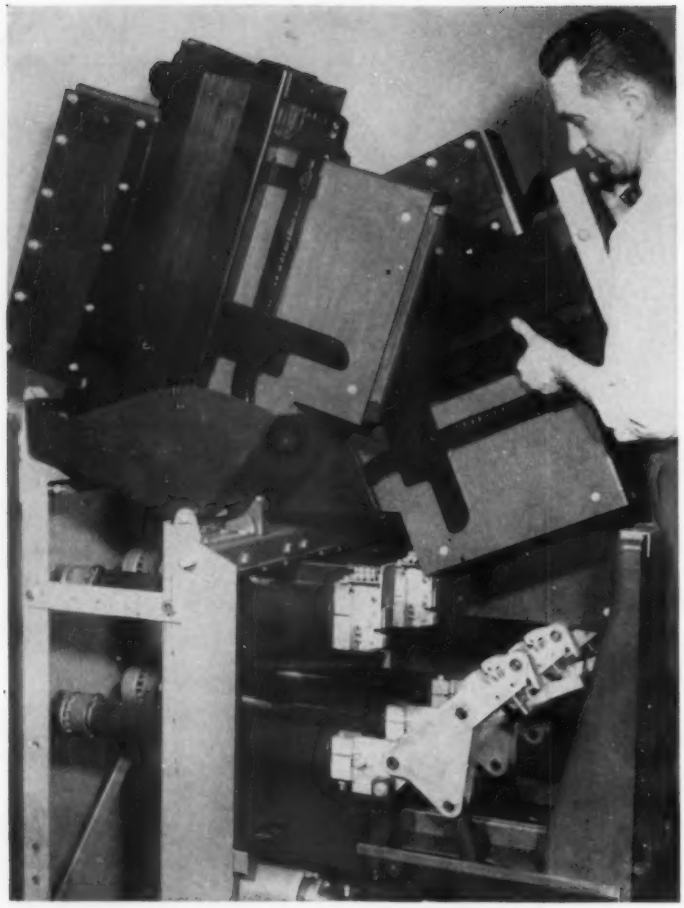
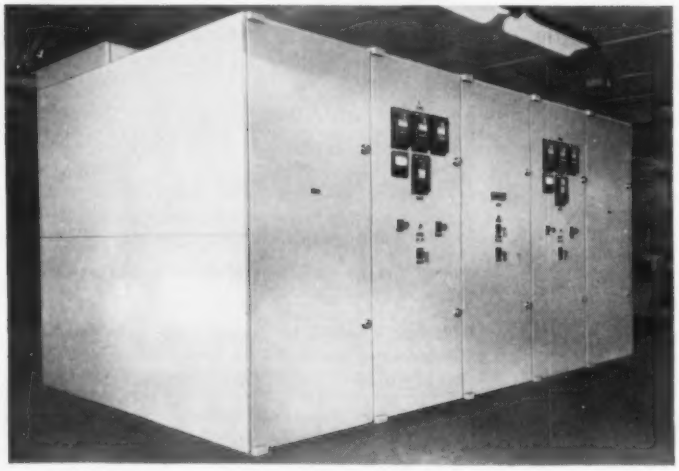


No cranes are required. Arc chutes pivot. Rest on fixed stop. Illustration shows 15 kv magnetic air circuit breaker.



I-T-E Switchgear in 15 kv rating. All I-T-E circuit breakers are horizontal drawout, interchangeable in like ratings.

TILTING ARC CHUTES

New I-T-E development for 15 kv air circuit breakers

The saving of time and effort which the new I-T-E tilting arc chutes make possible can best be appreciated by anybody who has ever removed the other kind. When inspection time comes, there's no crane lifting of heavy assemblies, no danger of dropping and damaging valuable parts. The arc chutes pivot back safely out of the way for easy inspection of contacts and arc plates. Only I-T-E makes magnetic air circuit breakers with this convenient, modern feature.

I-T-E Metal-Clad Switchgear is made in three basic ratings (5 kv, 7.5 kv and 15 kv), and will interrupt through 500,000 kva. Throughout the line, time-proved features add extra value. Circuit breakers are jig fitted to enclosures. Welded, rigid frames and housings can be lifted as a unit without losing alignment. Complete isolation of compartments insures safety and continuity of service.

Take advantage of I-T-E planning and engineering assistance when you order switchgear. It assures you protection with economy, plus better performance. For details, contact the I-T-E field office nearest you—look in your classified directory under "Electric Equipment." Or write for Bulletin 7004C. I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Phila. 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY Switchgear Division

Tube-weld

...a new concept in electric fitting design!

Look closely at every detail of this new line..."Tube-Weld". *Its advantages are basic!*

All fittings are precision-made of one piece heavy gauge welded steel tubing which has been accurately drawn and sized for controlled uniformity. These fittings cannot open or spread and far surpass U L requirements.

They are made by Electric Tube Products, a division of Berger Machine Products, with over 36 years manufacturing experience.

Tube-Weld fittings represent an entirely new concept in quality, design and price. *They are available in ½", ¾" and 1" sizes* and have the *following features:*

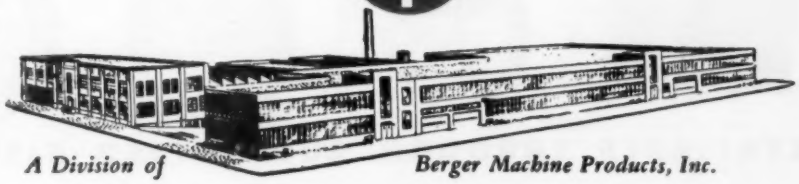
- Oversized hardened steel set screws are used throughout and are *staked for permanency!*
- Extra long length of offsets provide exceptionally easy pulling of wire.
- Longer length of fitting provides maximum support for conduit.
- Connector shoulders are uniformly flat assuring perfect centering in the box.
- All threads are rolled instead of cut and have 54% greater stripping strength and 66% greater snapping strength (independent testing laboratory report) over cut threads.
- Lustrous zinc finish and carefully beveled edges add a distinctive appearance – allow largest inside working diameters.
- Carefully and smartly packaged for ease in shelving and identification. For descriptive brochure and additional information write or call:

Electric Tube Products

74-16 Grand Ave., Maspeth (N.Y.C.) N.Y.

DEfender 5-8000

CONNECT WITH ETP FOR ECONOMY



A Division of *Berger Machine Products, Inc.*

cables spliced for life

WITH OKONITE

rubber splicing Tapes

1 PERFECT BONDING
Okolite and Okoprene Tapes bond firmly together, eliminating air or moisture-filled danger spots.
2 NO SEPARATE LAYERS
Okolite Tape has fused into a solid mass, perfectly bonded to the cable insulation.
3 NO AIR POCKETS
Impression left by conductor strands shows absence of voids.

Unretouched photo of cutaway splice

All too frequently, cable failures are traced to bad splices. Careful splicing alone is not enough; the use of high-grade splicing materials is essential and economical in the long run. Okonite splicing tapes have proved themselves in the severest test of all—uninterrupted long-time service under all installation conditions.

The cutaway section of a 5kv unshielded cable splice shown here demonstrates perfectly the elements that make up a long-lasting splice. The perfectly bonded, homogeneous wall provided by Okolite and Okoprene Tapes prevents dangerous air pockets that result in a weak insulating joint.

Okolite High Voltage Tape was developed by Okonite engineers for splicing all rubber-insulated cables made with ozone-resisting compounds, particularly for those cables operating over 2000 volts. A single thickness of Okolite Tape has a dielectric strength of more than 17,000 volts. It is ozone and moisture resistant, has a high insulating resistance and excellent aging properties. Okoprene Tape, applied over the Okolite insulating tape, gives the lasting protection of a neoprene sheath to all types of cable splices. Highly resistant to weather, oil, acids and heat, Okoprene Tape gives additional protection through its high dielectric strength of over 7500 volts per single thickness.

Bulletin EC-1089 gives full details on all Okonite splicing tapes, and on the reasons they mean better splices. Write for it today. The Okonite Company, Passaic, N. J.

295L

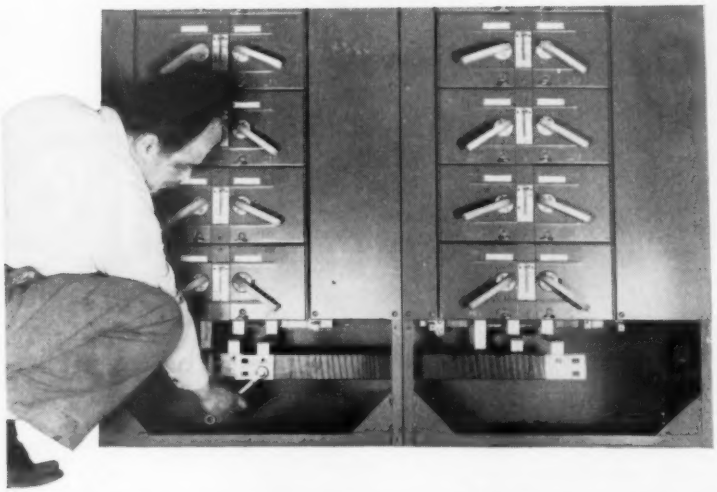
AVAILABLE THROUGH AUTHORIZED DISTRIBUTORS ONLY

ADD CAPACITY WHENEVER YOU NEED IT! So simple. Just attach another section. And be assured you're using the best. The Unit-Versal Switchboard is the only one you can get with famous Vacu-Break switch units to smother arcs, decrease maintenance.

BULLDOG UNIT-VERSAL VACU-BREAK SWITCHBOARD

Tailors Itself

to today's and tomorrow's power requirements



INSTALLS, EXTENDS, CONVERTS WITH ONLY A WRENCH AND A SCREWDRIVER!

What is adequate today may be inadequate tomorrow. But this need not be true in switchboards. For BullDog—pioneer in electrical distribution—has developed and perfected the Unit-Versal Vacu-Break® Switchboard.

It is the one, low-cost unit of its kind that permits you to *add, remove or change* switches and breakers simply and easily. Or double, triple, or quadruple the branch-circuit capacity of the switchboard itself by just attaching standardized sections. Also, its design is so simple, you can install, extend or convert it swiftly with only a wrench and a screwdriver.

Look into BullDog's safe, efficient Unit-Versal Switchboard. For that matter, check all of BullDog's advanced electrical products. BullDog Field Engineers will be happy to lend you a hand from planning to installation. No obligation, of course. Write BullDog Electric Products Company, Detroit 32, Michigan.

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IF IT'S NEW
. . . IF IT'S DIFFERENT
. . . IF IT'S BETTER . . . IT'S

BULLDOG

ELECTRIC PRODUCTS COMPANY

A Division of I-T-E Circuit Breaker Company

Export Division: 13 East 40th Street, New York 16, New York. ***In Canada:*** BullDog Electric Products Company (Canada), Ltd., 80 Clayson Road, Toronto 15, Ontario.

OSTER presents the new

"Featherweight Champ"

ONLY 80 LBS. BUT PACKED WITH *Power*

EASY TO MOVE...

EASY TO USE...

The all new Oster "Featherweight Champ", a Power Drive for Hand Pipe Tools, weighs only 80 pounds. One man can move it and use it with ease . . . yet the "Featherweight Champ" is exceptionally sturdy and powerful. A real on-the-job profit maker, its threading range is ⅛" to 2", and it is available with either electric or gasoline power.

For the full story on the "Featherweight Champ" see your local Oster Distributor. He will give you sound recommendations on how to solve your pipe-threading problems . . . and he offers you speedy delivery and reliable service.

THE OSTER MANUFACTURING CO.

Main Office and Factory:
2081 East 61st St., Cleveland 3, Ohio

Builders of Cost Reducing Threading Equipment Since 1893

Roller-Smith

PROUDLY ANNOUNCES the

NEW...

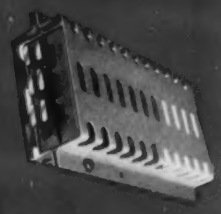
UNI-BUS BUSWAY

A New Concept in busway systems that obsoletes all other methods of carrying current.

- Low Voltage Drop in ***PLUG-IN*** AND ***FEEDER*** TYPES.
- High Short Circuit Strength in ***PLUG-IN*** AND ***FEEDER*** TYPES.
- ***ONE FLEXIBLE FITTING*** makes elbows, offsets —simplifies engineering and eliminates costly delays.
- ***COMPLETE SAFETY*** because live bus bars at plug outlets and live connections in plugs are eliminated.

And All at Lower Cost!

Roller-Smith
CORPORATION
ELECTRICAL SWITCHGEAR
BETHLEHEM, PENNSYLVANIA



ECONOMY

New slip-on hanger and lighter weight busway mean less installation time. Feeder system often costs less than conduit and wire, yet is 100% reusable.

FLEXIBILITY

Flexible connector eliminates all special fittings so that a minimum number of components meet all job requirements. Plug-in and feeder systems interchangeable.

SAFETY

Interlocked safety slide over plug outlet cannot be opened until covered by plug. Interlocked cover and visible contacts in plug are positive assurance of safety.

In the main operating room at the new Fairview Park Hospital, Cleveland, Ohio...

SCOTCHLOK and SCOTCH 33 BRAND

are timesavers—and lifesavers, too!

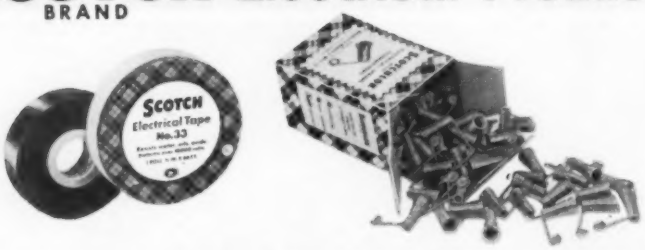
FAIRVIEW PARK HOSPITAL, *Cleveland, Ohio*

Safe splices are *vital* on a job like this! That's why the Harrington Electric Company chose "SCOTCHLOK" Electrical Spring Connectors and "SCOTCH" Brand Plastic Electrical Tape No. 33 for wiring in the new Fairview Park Hospital, Cleveland, Ohio. And this "SCOTCH" Brand team saved them *time*—and saved them *money*, too.

What could be easier and more dependable than a "SCOTCHLOK" connection? The spring construction of "SCOTCHLOK" grips the wires like a fist of steel that never lets loose. And all you do is wrap it with "SCOTCH" 33—the original, and still finest plastic electrical tape—for neat, compact results.

Try this top team on your next wiring job! For further information, write Minnesota Mining and Manufacturing Co., Dept. CB-65, St. Paul 6, Minnesota.

SCOTCH BRAND Electrical Products



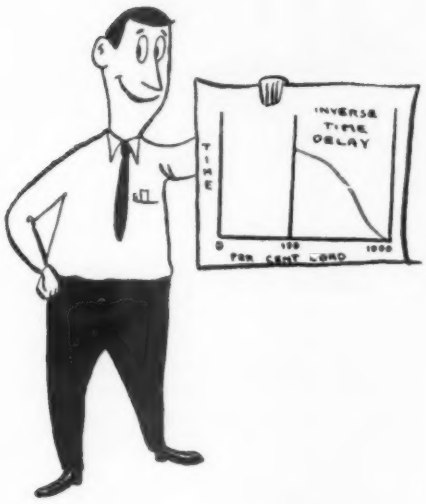
The term "SCOTCH" and the plaid design are registered trademarks of Minnesota Mining and Mfg. Co., St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

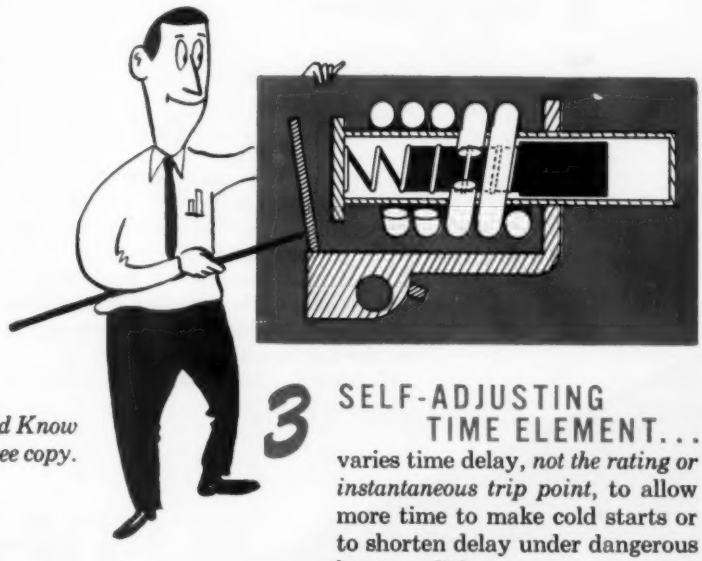
3M COMPANY

ONLY HEINEMANN CIRCUIT BREAKERS give you all THREE

1 **A DEFINITE RATING . . .** unaffected by temperature. A 20 ampere rating means 20 amperes of safe, usable capacity. There is no de-rating of Heinemann Circuit Breakers.

2 **INVERSE TIME DELAY . . .** prevents nuisance power interruptions . . . permits starting inrush and harmless, temporary overloads. Gives maximum protection without inconvenience.



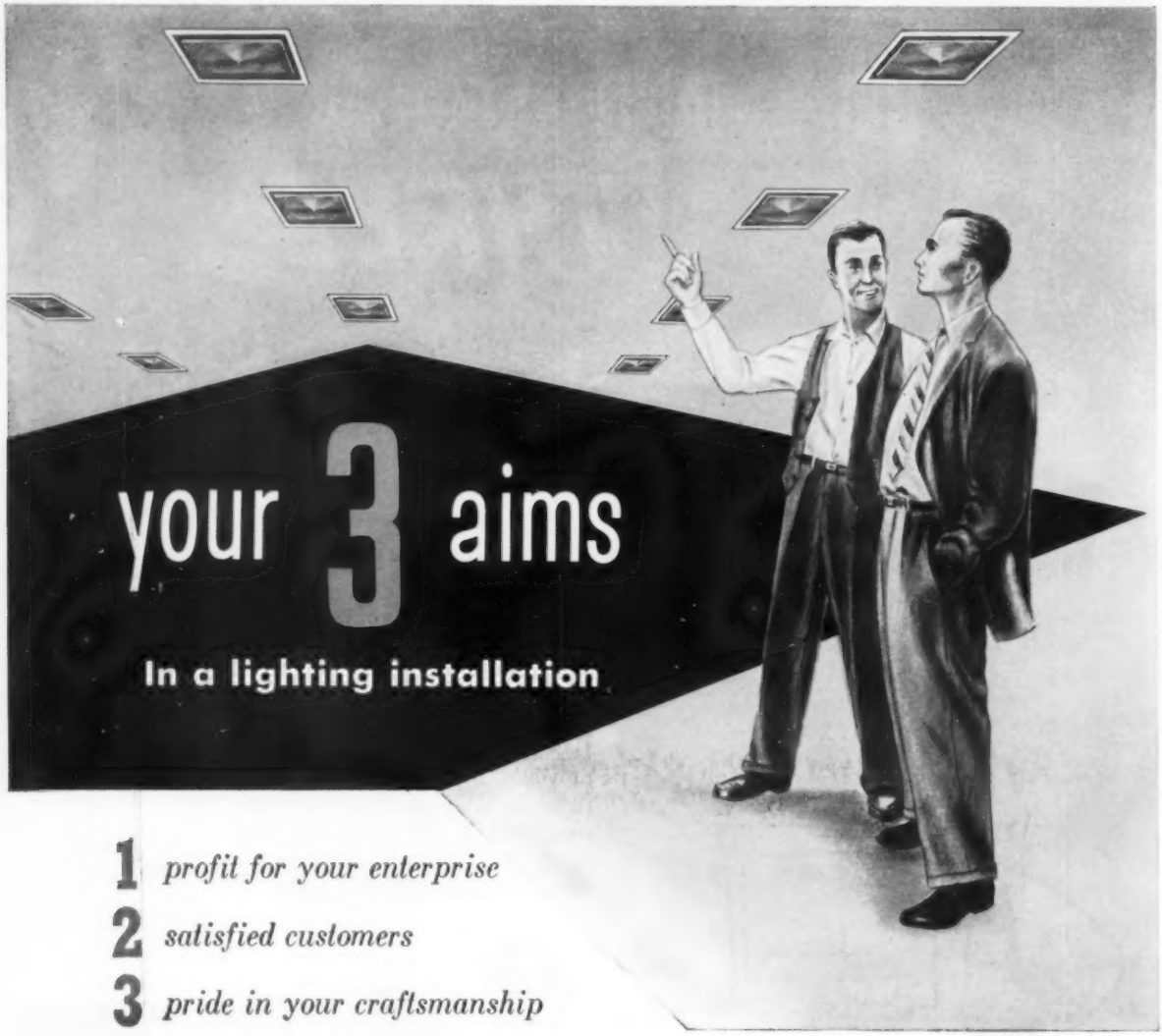


3 **SELF-ADJUSTING TIME ELEMENT . . .** varies time delay, *not the rating or instantaneous trip point*, to allow more time to make cold starts or to shorten delay under dangerous heat conditions.

INFORMATIVE BOOKLET: *"What You Should Know About Circuit Breakers"... Send for your free copy.*

HEINEMANN *Circuit breakers*

HEINEMANN ELECTRIC COMPANY
132 PLUM STREET
TRENTON 2, N. J.



1 *profit for your enterprise*

2 *satisfied customers*

3 *pride in your craftsmanship*

Surprising as it may seem, the continued use of top quality electric equipment is your surest means of achieving all three of these objectives.

When you consider all the elements that go into a job, including your installation time, it costs less in the long run to use the best equipment obtainable.

Customer satisfaction and pride in your workmanship invariably follow a job that used good equipment, well installed. It's a risk to your reputation to skimp on quality in materials or workmanship.

For your lighting requirements, ART METAL has the equipment to suit every particular need. And it will help you achieve *your* big three objectives.

May we suggest you write for the New Art Metal Catalog No. 455 for all your lighting requirements.

The **ART METAL** *Company*

CLEVELAND 3, OHIO

ROECLAD PORTABLE POWER CABLES

TYPE G ROECLAD CABLE – with ground wires – for service to 5000 volts.

TYPE W ROECLAD CABLE – without ground wires – for service to 2500 volts.

TYPE SH-A, B, C or D ROECLAD CABLE – shielded, with or without ground wires – for voltages above 2500 – made in four different applications of shielding and ground wires.

YOU WANT

- RUGGEDNESS – FOR MAXIMUM LIFE IN TRANSMITTING POWER TO MOBILE EQUIPMENT UNDER TOUGHEST CONDITIONS;
- CABLES THAT ARE TAILOR-MADE FOR YOUR OWN PARTICULAR REQUIREMENTS;

IN SHORT,

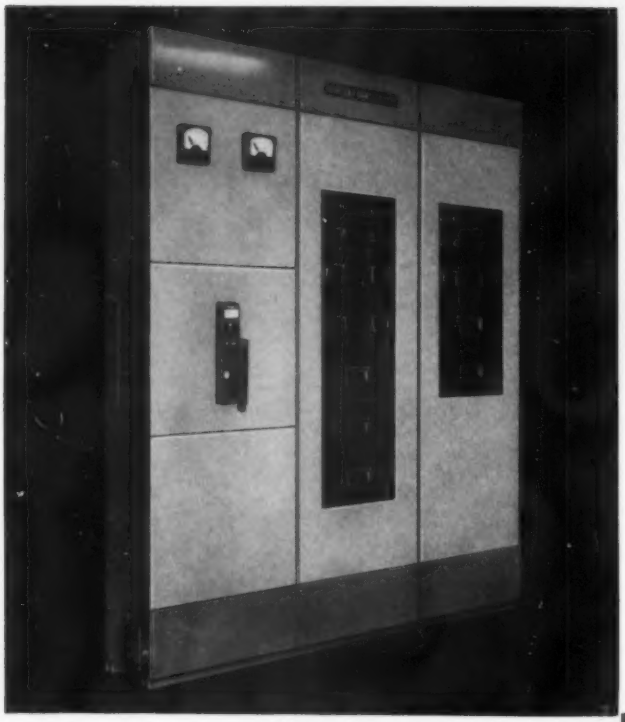
YOU WANT

ROEBLING

Subsidiary of The Colorado Fuel and Iron Corporation

JOHN A. ROEBLING'S SONS CORPORATION, TRENTON 2, N. J. BRANCHES: ATLANTA, 934 AVON AVE. • BOSTON, 51 SLEEPER ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 3253 FREDONIA AVE. • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST. • DETROIT, 915 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. • ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, TRENTON 2, N. J.

NEW G-E MULTI-PURPOSE SWITCHBOARD AND CURRENT-LIMITING BUSWAY FEATURE GREATER ECONOMY, EASIER INSTALLATION



Two new G-E developments—a standardized, multi-purpose switchboard and a protective-type busway—add new flexibility, reliability, safety and economy to secondary distribution systems. These two new developments make G-E "system engineered" distribution equipment an even better answer to the two-fold increase in power consumption expected in the next ten years. Check these advantages, for example:

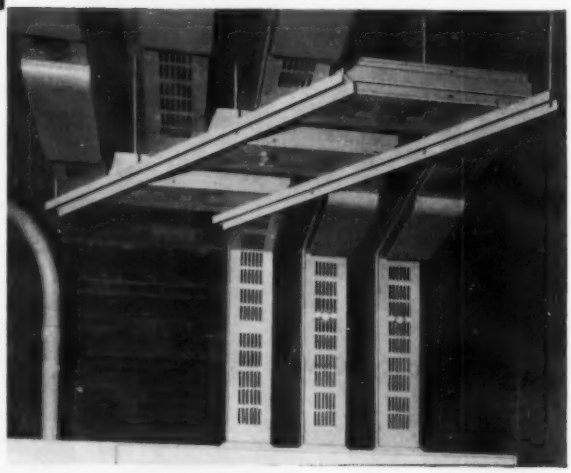
The new standardized multi-purpose Type MP switchboard—designed for industrial, commercial or institution-type buildings:

- requires lower initial investment.
- requires less space.
- is standardized to make on-the-job additions or changes easy.
- is designed for greater operating efficiency.
- lines up with other G-E equipment (control centers, for example) which helps in planning both original and later expansion.

Type CL (current-limiting) busway introduces new safety, economy and dependability into power distribution. G.E.'s new Type CL busway:

- in many cases eliminates the need for current-limiting fuses or reactors, thereby reducing equipment investment on many jobs.
- reduces the short-circuit currents to values easily handled by lower-cost conventional equipment.
- serves in dual capacity—acting both as a feeder and a current-limiting protecting device.
- operates on short runs with relatively low voltage drop.

For full information on these new products, ask your G-E Distributor or Representative, or write GENERAL ELECTRIC COMPANY, DISTRIBUTION ASSEMBLIES DEPARTMENT, PLAINVILLE, CONNECTICUT.



Progress Is Our Most Important Product

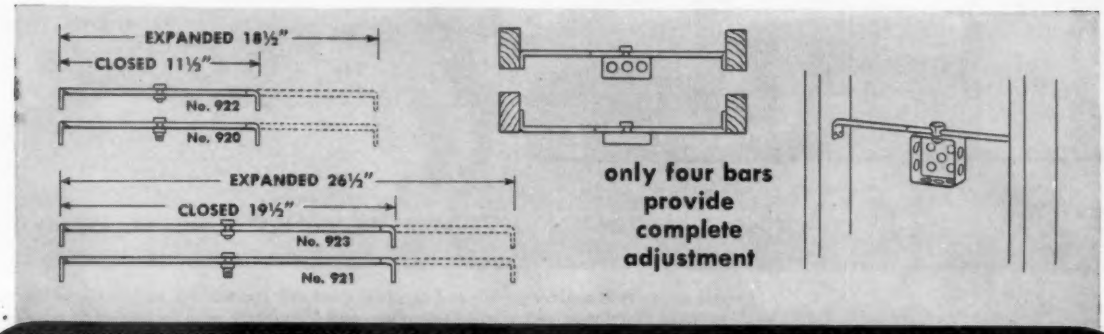
GENERAL ELECTRIC

NOW! RACO OFFERS

the first adjustable bars that fill every requirement... pass every test!

ONLY 4 BARS ENABLE YOU TO INSTALL ANY DEPTH BOX WHEREVER YOU WANT IT REGARDLESS OF STUDDING SIZE OR SPACING

STOCK JUST 4 BARS INSTEAD OF 16



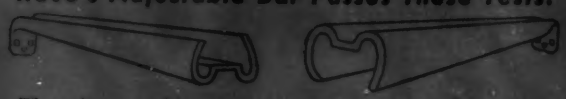
NORMAL SAFETY PRECAUTIONS REQUIRE THAT A BAR MUST WITHSTAND THESE TESTS

1. Direct pull on stud of 200 pounds for 5 minutes.

2. Six rotations of a 30 pound pull, 20" away from stud at a 30° angle in one minute.

3. A torque of 20 pounds at 20" horizontally from stud for one minute.

Raco's Adjustable Bar Passes These Tests!



There is strength to spare due to these special formations!

Use Raco's New Clip or Popular Stud!

The new Raco Clip uses a strong new saddle of 13 gauge steel, formed steel clip and short, strong No. ¼-20 round head screw.

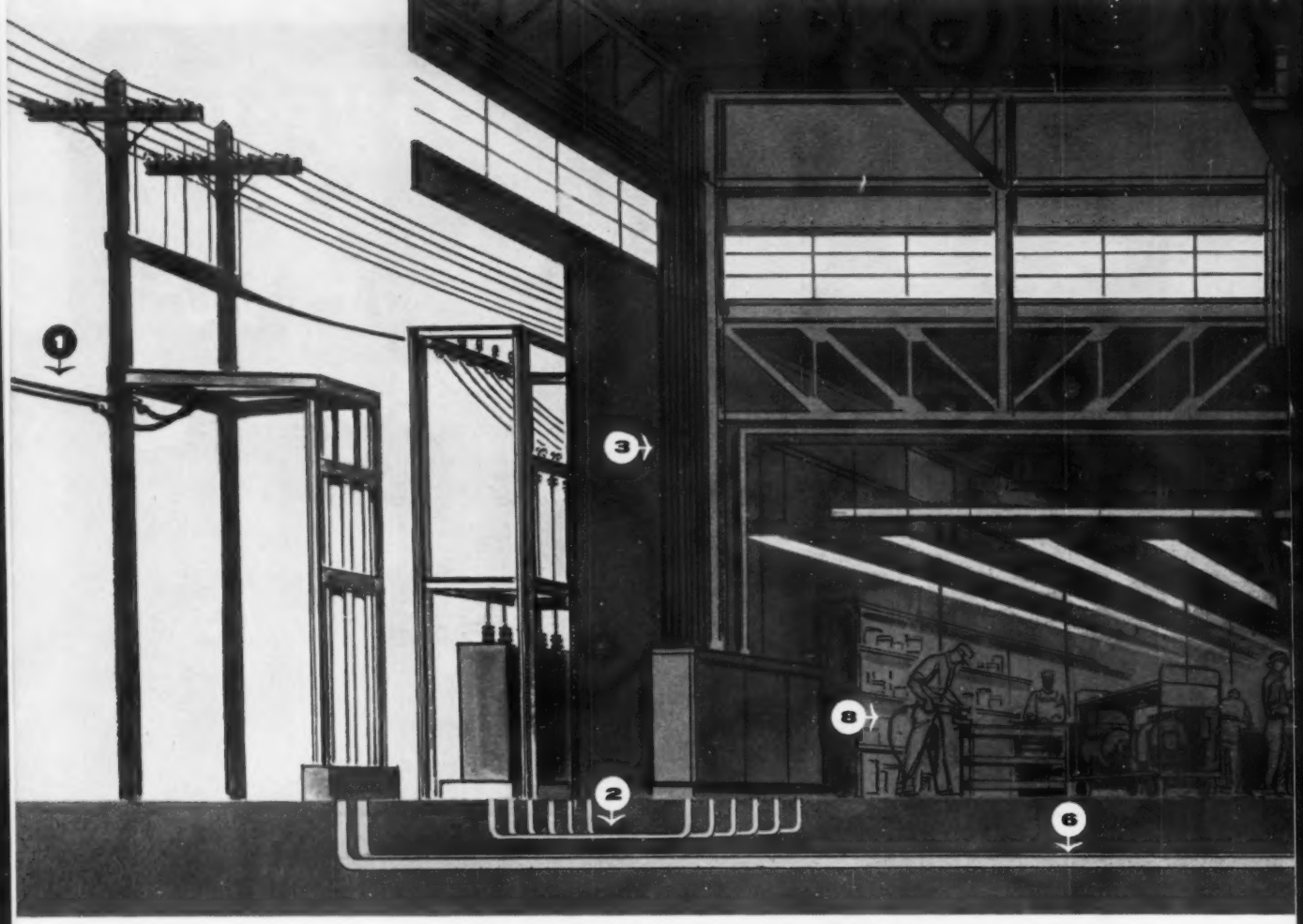
Popular Raco Stud uses the same saddle, a formed 13 gauge steel stud with six full, deep No. 20 threads and a stout No. ¼-20 screw.

Raco Clip provides ample room for device and added wiring space in any type box.

WRITE TODAY • *get complete information on Raco Bar Hangers*

YOU CAN ALWAYS DEPEND ON RACO

ALL-STEEL EQUIPMENT INC. Aurora • Illinois



All around the plant, modern Anaconda wires and cables help industry reap the benefits of more efficient power, greater reliability, and long-range economy. Read on the following page the exciting facts about 1) new Aerial Cable, 2) new AHW moisture-resistant cable,

IT'S TIME TO TAKE A

Most manufacturers know inadequate plant wiring slows production and skyrockets costs.

But wiring can be adequate and still waste money—because it's obsolete! Here from Anaconda are the facts on what you can do to make your wiring as up-to-date as the rest of your operations.

3) rugged, corrosion-free Durasheath neoprene-jacketed cable used as feeders, 4) low-cost interlocked Armor Cable, 5) new Control Cables, 6) ozone-resistant Butyl insulation for high-voltage cable, 7) Powerduct flexible busduct cable that increases the efficiency of busway systems, and 8) portable cords.

NEW LOOK AT WIRING!

Plant wiring today has become a major concern for management everywhere.

The reasons are easy to see. Shifting plant requirements, new tools, new materials, new handling procedures—*all* the great changes in modern industry are bringing with them special problems in power.

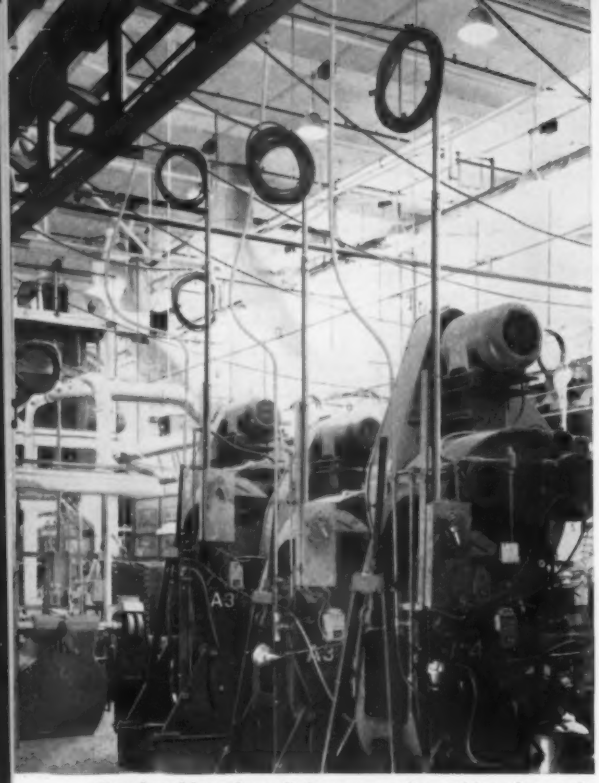
How these problems are solved has a direct bearing on your profit picture.

Since most plants were built – including some only a few years old—vast advancements in wires and power cables have taken place.

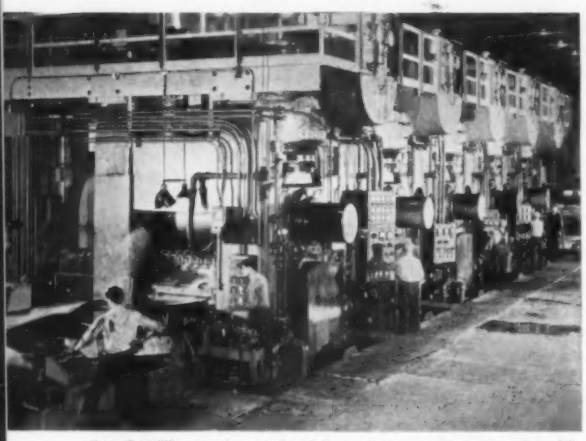
For example – new, thinner insulations today squeeze more capacity from existing conduit. New heat-resistant compounds boost wire current-carrying capacity. Tough new jacketing materials increase cable life. New cable designs enable manufacturers to find even more jobs for low-cost, efficient electric power.

Top management has a big stake in seeing that plant wiring is up-to-date. Though you must rely upon the knowledge and experience of qualified electrical experts when wiring up, acquaintance with modern industrial wires and cables will help you guide your company to sound decisions.

TURN THE PAGE AND SEE WHAT MODERN WIRING CAN DO FOR YOU



Metalworking plant eliminates expensive rewiring when equipment must be moved—by using *flexible* Anaconda **Powerduct Cable** from busduct to machine.



Steel Mill uses thousands of feet of Anaconda **Control Cable.** Modern insulations and jackets give most reliable service ever where there's heat and moisture.

IT'S TIME TO TAKE A NEW LOOK

7 ways modern costs down,

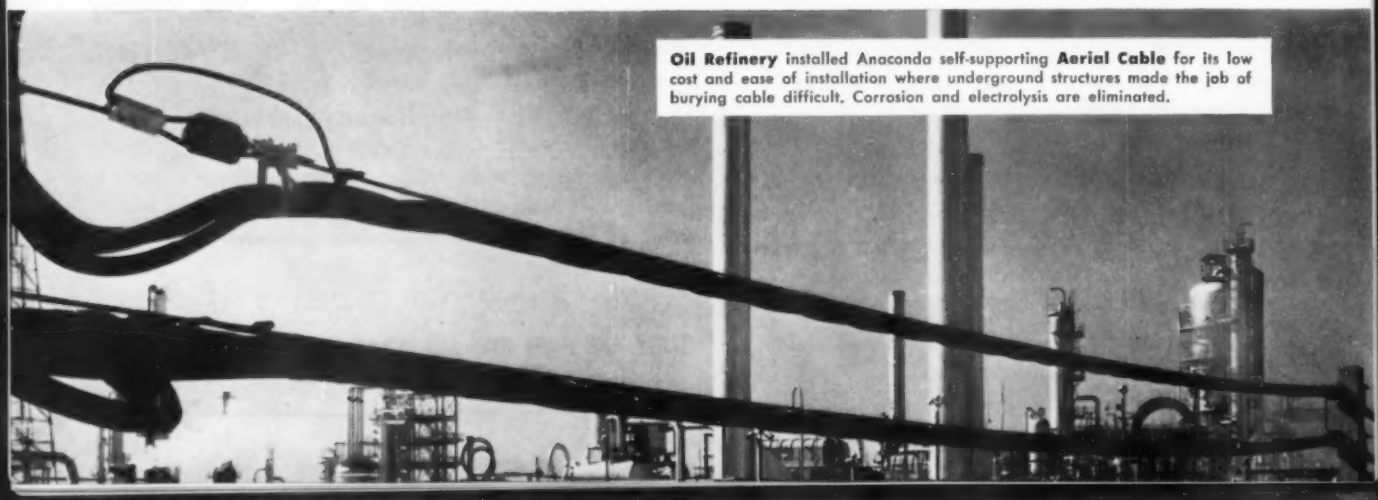
The nerve-system of your plant is its electric wires and cables. And now — with new production and operating factors in the picture — it's time for a basic survey. If they're obsolete, it will pay you to replace them . . . with new, more efficient, more economical ones.

Modern wiring has seen a wealth of new developments. Let's take a quick look at 7 of the most important of these *in light of changes that have probably taken place in your plant* since the original wiring was installed.

1. **NEW HIGHER VOLTAGES.** The trend to higher plant voltages — with its resulting savings in cable costs and line losses — poses a new problem: ozone, a by-product of high voltage, destroys ordinary insulation . . . and causes premature cable failure. Anaconda engineers have solved this problem with pioneering work in new *butyl* rubber. It has *inherent* resistance to ozone. Higher voltage (and ANACONDA butyl-insulated power cables) ought to come high on your list of cost-cutting ideas to talk over with your electrical department or contractor.

2. **NEW CABLE HAZARDS.** Chemicals, moisture, oil — natural to most modern plants — are tough on cable. Engineers at Anaconda have come up with an answer: Durasheath* rubber-insulated, neoprene-jacketed cable for all voltages. This rugged cable resists almost *every* enemy of cable life. Use it everywhere — aerially, in ducts, or buried directly in the ground — you'll find it reduces downtime, maintenance and replacement costs.

3. **NEW OPERATING CONDITIONS** put new demand upon wiring. Higher loads generate higher heat in cable . . . and more heat in cable installed underground or in other



Oil Refinery installed Anaconda self-supporting **Aerial Cable** for its low cost and ease of installation where underground structures made the job of burying cable difficult. Corrosion and electrolysis are eliminated.

AT WIRING!

wiring keeps production high

moist locations is tough on cable insulation. Today, AHW rubber insulation, used on many ANACONDA rubber power cables, does the best job ever in withstanding *heat and moisture together* at 80C operating temperature.

4. **NEW EQUIPMENT.** The addition of process-heating equipment, process or comfort air conditioning, or new production machines calls for more wiring to carry the load. ANACONDA Interlocked-Armor Cable can be installed up to 40% quicker than many other types of cable because it needs no conduit. You save time and money when the cable is installed – and later, too, if cable must be moved.

5. **MODERN BUSWAY SYSTEMS.** Today you can *increase* the flexibility of your busways – with Anaconda's flexible Powerduct* Cable. It just plugs into the busduct . . . and unplugs when you want to move machines. There's no costly conduit to put up or rip out. And the cable is 100% salvageable on every move!

6. **NEW POWER.** When additional power is needed, ANACONDA Aerial Cable is today's popular choice for the job, especially where the ground is packed with pipes and other structures or contains corrosive agents. It is fast, easy to install even between closely spaced buildings where clearance is limited. It's neat, safe, lower in cost than underground systems, and gives highest *reliability*.

7. **NEW ELECTRIC EQUIPMENT.** The trend to automation and more complex machines puts new emphasis on control cable. The job cannot be left up to cable whose performance is just "so-so." Anaconda's years of cable experience has paid off in a new full line of control cables – with modern types of insulations and coverings to give them highest reliability. These cables assure you the best possible service from your new equipment.

This advertisement provides only a few examples of how modern Anaconda wires and cables help industry wire up for more economical, more efficient production. Your electrical department or electrical contractor can give you personal and expert assistance with your needs.

*Reg. U. S. Pat. Off.

55314

see the man from

ANACONDA®

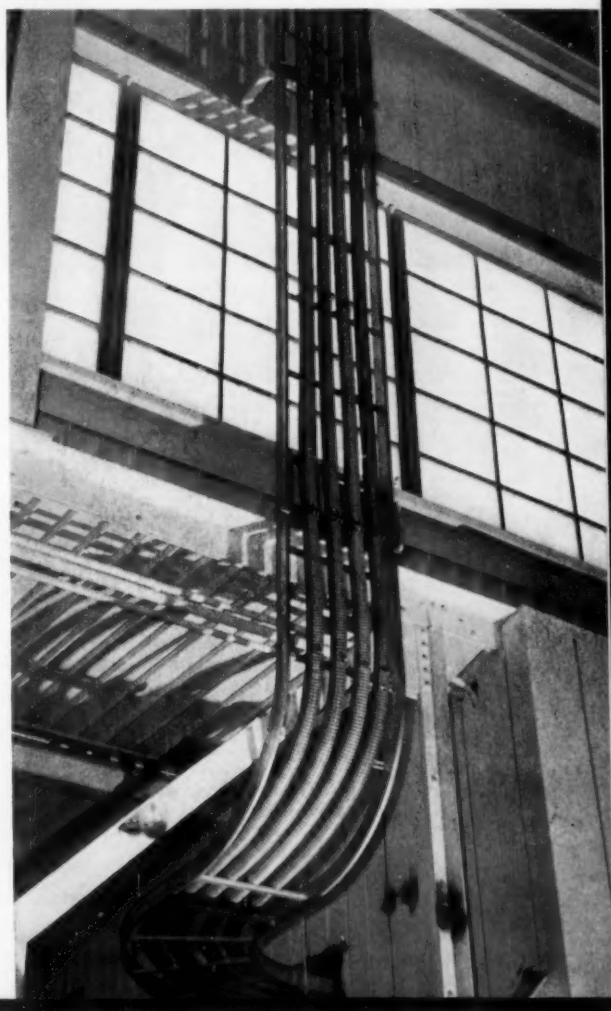
about your

POWER CABLES

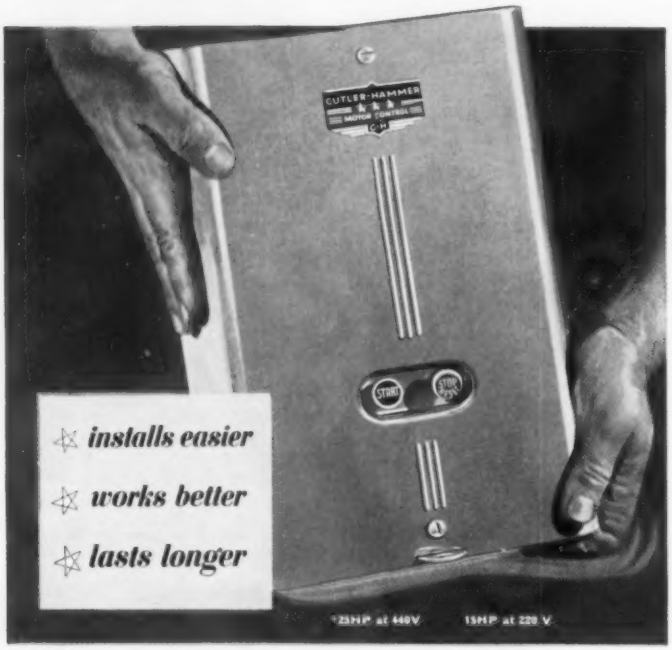
ANACONDA WIRE & CABLE COMPANY,
25 BROADWAY, NEW YORK 4, NEW YORK

Chemical plant installed thousands of feet of Anaconda **Dura-sheath Cable** for power and lighting. Rugged neoprene jacket resists heat, moisture, acids and alkalies.

Assembly plant reaped high-cost savings by installing flexible, quickly placed Anaconda **Interlocked-Armor Cable** from unit substation.

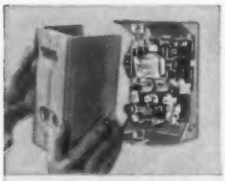


Now Cutler-Hammer ★★★ Motor Control in NEMA Size 2 for motors up to 25 HP*



It is here . . . Cutler-Hammer ★★★ Motor Control for your larger motors, NEMA Size 2 Starters with the famous three stars on the Cutler-Hammer nameplate. The three stars that stand for three entirely new standards in motor control performance and value. Star #1: Installs easier. So much easier that installation savings often exceed the cost of the control. Star #2: Works better. So much better that this control often pays for itself many times over in just the production interruptions it avoids. Star #3: Lasts longer. So much longer that this control *never* needs maintenance care or expense in 90% of its uses. If you are one of the many users who have proved these are facts, not mere claims, you will welcome the news that your larger motors can now have this same control. Order Bulletin 9586, Size 2, today from your nearby Cutler-Hammer Authorized Distributor. He is stocked and ready to serve you. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin.

CUTLER-HAMMER
★ ★ ★
MOTOR CONTROL
C-H



3-D Accessibility

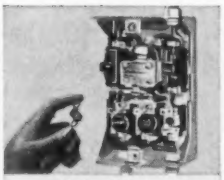
Removing the wrap-around cover bares the entire starter for three-directional accessibility. It is wide open at front and both sides. You can see everything and reach anything. Wiring the starter is simplified and routine inspection is made so easy and complete nothing is ever neglected.

Unit Panel Construction

The entire starter mechanism can be removed from its case by simply loosening three screws. With mechanism out of the way, mounting case, connecting conduit and pulling wires is a cinch. A great time saver. No skinned knuckles. No damaged starter mechanisms.

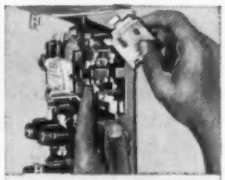
Full Three-Phase Protection

Only *three* overload relays can provide positive three-phase protection to stop needless motor burn-outs and production interruptions. And only Cutler-Hammer offers three overload relays in *standard* starters without the excessive costs and delays of special starter constructions.



Adjustable Sensing Coils

Only the accurate adjustment of overload protection permits motors to work harder without damage. Now more important than ever with newer type small frame motors. Only C-H offers adjustable load sensing coils . . . for 3% loading accuracy instead of the 10% to 12% in all other controls.



Superlife Vertical Contacts

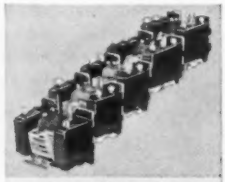
Now the famous C-H dust-safe vertical contacts have been doubly improved. New light-weight design cuts bounce to reduce arcing. Also, arcing is now pressure-quenched. Contact maintenance care and costs are ended for all time in all normal motor control uses.

For Control Panel Designers

The new Cutler-Hammer ★★★ Motor Control offers an array of spectacular new features to provide many exclusive advantages in circuit planning, compact panel design, better motor protection and better control performance. Be sure you have complete design data on this advanced equipment. Write or wire today.

New Control Components

All parts of the new C-H ★★★ Starters in NEMA 0, 1 and 2 Sizes are available as components, also complete starters on convenient unit panels. Electrical interlocks are available to provide additional control circuits when desired.



New Control Relays

Finest of control relays. 10 and 15 Amp. 2-3-4-5-6 poles. All contacts instantly convertible from NO to NC or vice versa. NO or NC status seen at a glance without removing cover. New armored magnet coils color coded for voltage and frequency.

New SD & HD Pushbuttons

New standard duty pushbutton station with pilot light offers many exclusive features, typical of complete C-H line. Watch soon for announcement of the revolutionary new line of C-H heavy-duty oil-tight one-hole mounting pushbuttons.

ELECTRICAL CONSTRUCTION AND MAINTENANCE

54th Year —JULY • 1955

Lighting With 400 Cycles

The new high-cycle fluorescent lighting system at Union College Field House may represent an important break-through in design and installation practice. The fixtures are energized through a wiring system operating at 600 volts, 300 volts to ground, and at a frequency of 400 cycles per second supplied from a pair of frequency changers.

Significantly, the system was designed and installed on strictly lighting-performance-per-dollar considerations. The particular lighting problem, while unusual in the dimensions of the space involved, is comparable to many other applications found in industry and commerce. Consequently high-cycle fluorescent lighting looks like a new and challenging factor in electrical progress.

The special advantages of higher frequencies for certain uses are well known. Much military equipment is standardized at 400 cycles. Many production power tools and machine tools use multiples of 60 cycles to attain high power and speed from compact and light weight motors. And optimum performance of fluorescent light sources is reached at frequencies above 300 cycles.

Commercial feasability of high-cycle fluorescent lighting in buildings served from conventional 60-cycle utility lines, indicated by the Union College Field House job, could set off significant developments not only in lighting but in other applications where a higher frequency could be used to advantage.

Not so long ago, modifications of electrical supply characteristics between the service entrance and the utilization device were comparatively rare. Askarel and air-cooled transformers and totally enclosed switchgear brought voltage transformation into the factory. Today the engineer chooses an optimum distribution voltage and takes off at load centers whatever utilization voltages are best suited to the equipment to be served. The transformer frees the application engineer from the limitations of supply voltage. The frequency changer, which can also change voltage, offers him freedom from the limitations of supply frequency as well.

The prospect of high-cycle lighting is a new and welcome addition to the practical technology of a dynamic industry.

Wm. T. Stuart

WHATEVER THE SIGNALING NEED — you can get the proper equipment from your local Graybar office. Edwards Lokator code-paging or calling systems . . . Webster intercommunication systems . . . USI sound-powered telephones . . . fire alarm systems . . . *plus* bells, buzzers, horns, sirens, howlers — *all* are reliable products made by leading manufacturers. Call your near-by Graybar Representative for complete information on any item.

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ELECTRICAL
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New Planning Ideas for . . . .

Modernizing Apartment Houses

STEP 1: Make a thorough survey of electrical service, distribution and utilization in building to determine nature and extent of electrical inadequacy.

STEP 2: Roughly design an electrical system to provide adequate capacity for pre-determined load conditions; then include existing equipment in laying out design details.

STEP 3: Install modernized system, using techniques and equipment particularly suited to modernization work. To the maximum extent allowed by the installation methods used, provide ample reserve capacity in circuits and feeders to meet an estimated future load growth.

This is the second in a series of articles on electrical modernization practice in specific types of buildings. Like the first in the series—"Modernizing Office Buildings", Feb. 1954—this article has been prepared from the resources and wide experience of our own editorial staff. The methods, techniques and procedures described are tested and proved; the recommendations on electrical capacity conform to current adequate wiring standards. NE code references are based on the 1953 edition. Although all modernization jobs have their own peculiar problems and characistics, there are many elements of work common to all modernization in apartment houses. This article, therefore, primarily covers a wide range of the common considerations and only indicates how particular problems might be resolved.

Overall, the material is presented here in three steps, each of which involves distinct considerations. In pre-work analysis of an existing electrical system, we stress thoroughness and accuracy to assure profit in estimating the job. In design, we stress "adequacy" for convenience of modern electrical living, instead of the old "code minimum" which *only* looks to safety. And in installation, we stress use of quality material and conscientious craftsmanship as the surest way to more and better business.

STEP 1 - ELECTRICAL SURVEY

Apartment House Wiring System Survey

Address 106 Main St.

Owner OK Operating Co. No. Apt. Units 16 No. Rooms

No. Floors 4 Age of Bldg. 28 yrs.

Date of Survey 5/17/55 Time 6-9 p.m.

Part I. SERVICE Is space available to hang a temporary service equipt? Yes

Type Service 1φ - 240/120 Utility Bank of Tg. Co. Utility's Mains 3 # 00 R

Service Sw. 200A-2P&N Fuse 200A Condition Contacts bad Voltage at S/Sw. A-116 v B-116 v

Mains 3 # 00R Cap. 145A Condition Hot Amps at S/Sw-A 178 B 182 C

Comments Mains overfused - Service too small

Part II. DISTRIBUTION

Sub-main No.	Type Protective Device	Fuse Rating	Sub Mains	Capacity	Condition	Load A	Load B C	Apts or Panels Served
1	2P-100A fuse c/o	100A	3#6R	55A	hot	97	92	8 front
2	2P- 60A fuse c/o	55A	3#8R	40A	hot	45	43	4 top rear
3	2P - 30A fuse c/o	Solid jumper	3#10R	30A	hot	36	47	4 lower rear

Is metering equipt. usable with new load?

Type of Meters Single element 5A Location Basement No. Meter Banks 2 of 8 each

Comments Layout designed for 1800 watt load per apt.

Part III. RISERS

Apt. or Tag No.	Riser Protective Device	Fuse Rating	Raceway	Wires	Load	No. of Apts. Served	Location of Riser (if available)
1 - 1A	plug c/o	30A	½"C	2#14R-	21A	1 ea.	A apts. 40 ft. from service
2 - 1B	solid N				27		
3 - 2A					14		
4 - 2B					24		
5 - 3A					26		B apts. 20 ft.
6 - 3B					23		
7 - 4A					19		
8 - 4B		25A			21		
9 - 1C		30A			27		C apts. 80 ft.
10 - 1D					23		
11 - 2C					16		
12 - 2D					28		D apts. 70 ft.
13 - 3C					24		
14 - 3D		15A			13		
15 - 4C		30A			27		
16 - 4D		30A			25		

Comments

* Phasing of risers not easily traced.

FIG. 1 A SIMPLE SURVEY FORM like this can be typed up in the office and filled-in during the pre-work survey of existing electrical conditions. The form will provide speed and ease in collecting data on overload conditions.

SUCCESSFUL electrical modernization of any apartment house begins with a careful, thorough survey of existing electrical facilities. This survey should be made before any conclusions or decisions are made about actual work to be done. Only from a careful analysis of the existing installation can the symptoms of electrical inadequacy be appraised. And only from a clear understanding of system bottlenecks can modernization be scaled to the requirements of any apartment house.

Basically, information to be obtained from a survey can be divided into four groups:

1. System analysis—This consists of a study of the physical layout of the entire electrical system: location of equipment, pattern of distribution, type of building construction, arrangement of service, basement layout, metering arrangement, system of risers, layout of apartments and branch circuit patterns.

2. Equipment analysis—This consists of careful determination of: the physical operating condition of all equipment in the system—wire insulation, switch contacts, moving mechanical parts, sockets, receptacles, etc.; sizes, types and ratings of separate elements of the system—wire, conduit, switches, panelboards, fuses, circuit breakers, boxes, cabinets and enclosures.

3. Ampere readings — These are made on individual conductors including: service conductors, sub-mains, risers, sub-feeders, branch circuits.

4. Voltage readings—Beginning at the service entrance, voltage readings are made at logical points of progression in the distribution system, i.e., at main switch, at origin of sub-mains, at origin of risers, at sub-feeder panels on individual floors and at individual apartment panels.

Survey data can be obtained with maximum accuracy in a minimum of time if the proper approach is made. The following steps outline a tested and proven procedure for making an electrical survey:

STEP 1. Make a date with building owner to make a survey. Arrange to have either the owner or the building superintendent with you during survey. Date of the survey should be arranged to allow sufficient advance notice to tenants that access to apartments will be required. All arrangements for the survey should be understood by all concerned to avoid lengthy explanations and discussions during the course of the examination.

STEP 2. Obtain any available plans of the building—both mechanical and electrical. Usually, sketches of riser diagrams or floor plans can be obtained. Of course, many such plans may not be 100% accurate because of changes or modifications made in the electrical system since the plans were drawn. But the main idea is to get as full an understanding of the building as possible before making the survey. Even only a general idea of the electrical layout can greatly aid in planning the survey to assure a minimum of travel within the building and a maximum of accuracy in obtaining data. Not only do plans provide an opportunity for careful planning of the survey, but they also afford a ready and logical sheet on which to make notes during the survey. Where plans are found to be incorrect during a survey, the actual existing conditions should be sketched on the plan. In the case where no plans at all are available for a particular building, a rough sketch of the existing system should be made during the survey.

STEP 3. Make the survey during peak load hours. Almost without exception for apartment houses, this occurs between six and nine o'clock in the evening. If there is any doubt about the time of peak load, a phone call to the local utility will quickly supply a definite answer as to the time and duration of maximum electrical load for multiple dwellings in the particular neighborhood.

In addition to making notes on available plans or sketching plans during the survey, a form of some sort can be used to logically and clearly notate survey data. Fig. 1 shows a typical form which can be typed up in the office and filled out during the survey. This sort of data sheet will prove invaluable as a working guide during later redesign and installation work. Included on the back of this sheet can be comments made during the survey on how various elements of the system might be modernized and expanded. All of preliminary survey and inspection should be made with careful attention to alternative possibilities for expansion.

Certain factors are basic to electrical modernization work and should be taken into consideration during the survey:

Available basement space for new equipment.

Spare conduit risers.

Space for running new risers.

Possible locations for individual floor panels.

Access to hidden conduit.

Space for new conduit on individual floors.

Expansion of apartment panels.

Possible use of surface raceway.

After a thorough survey of existing electrical conditions and after consultation with tenants and building management to determine needs and economic limitations, the next step in modernization is design of the new system according to current standards of adequate wiring.

STEP 2 - SYSTEM DESIGN

AFTER a comprehensive survey of the existing electrical layout and related mechanical and structural elements, modernization of the electrical system must be designed. Design must begin with a clear understanding of two factors: (1) load requirements and (2) economic limitations.

The present and future electrical utilization practices of the tenants should be determined by discussion with them. Their interest in obtaining major electrical appliances or other heavy load equipment should be sounded out. Interest in such equipment should be appraised in view of the average probable income bracket of the tenants, which determines their ability to purchase the equipment. The modernized electrical system must meet these load requirements as fully as possible within the economic limits imposed by the building owner. These limits should be fully discussed with the owner even before the survey.

Although the owner is vitally interested in economy of modernization, he often does not appreciate that in the long run a cheap job can really be the more expensive job. His decision on limits of reason for the modernization job should therefore be guided by sound advice on wiring and circuit adequacy. Patience, understanding and honest interest in doing the best job more often than not can convert an owner to the cause of electrical adequacy. At least there are always points to compromise where it can be clearly shown that X% more money now gives 5X% more wiring capacity and will save 10X% more money for more rewiring due to load growth in the next few years.

MODERN CIRCUIT DATA

Typical Loads	Average Wattage	Circuits Required	Size of Each Circ.	Number of Outlets	Remarks
Air Conditioner ¾ hp	1200	Separate Circuit	2#12 120-v	1	Use of 3-wire, 120/240-volt circuits to unit conditioners offers circuit flexibility for 120 or 240 volts
Air Conditioner 1½ hp	2400	Separate Circuit	3#12 120/240-v	1	
Range Top	3300	Separate Circuit	3#12 120/240-v	1	Use 3-wire receptacle
Broiler	1500	At Least Two Kitchen Appliance Circuits	2#12 120-v	As Convenience Requires	Use grounding type receptacles which also accept standard plug cap
Fryer	1300				
Coffeemaker	1000				
Refrigerator	300	Separate Circuit	2#12 120-v	2	
Freezer	350				
Washing Machine	1200	Separate Circuit	2#12 120-v	1	

Circuit Wiring

Design of a modernized electrical system for any apartment house begins at the points of electrical utilization, the individual apartments. First the size and number of circuits are determined to handle present and anticipated loads. Then the distribution system and service layout can be designed and laid out to carry the design circuit loads. The following discussions take into account a wide variety of possible circuit layouts within an apartment.

To an extent which depends upon their age, old apartment houses (and many not so old) suffer from circuit deficiency due to a steady, continuous growth in the use of electrical appliances and equipment—toasters, roasters, cookers, broilers, coffeemakers, fans, heaters, mixers, television, radio, refrigerators, freezers, air conditioners and in some cases laundry equipment. Of course, original design and layout of branch circuiting within the apartments made no provision at all for these loads or the load due to modern high levels of home lighting. Now these loads are being dumped on the one or two No. 14 120-volt circuits in old apartments, causing dangerous, overloaded, overfused wiring within apartments and creating low voltage due to drop in hot, inadequate risers. This low voltage, in turn, is causing faulty operation of the equipment, exposing motored appliances to damage from overload, blowing fuses and creating serious inconvenience.

Because of all these factors a common approach to design of branch circuiting usually involves taking the fixed and portable appliance loads off existing circuits and providing the necessary new circuits to take these loads. The old circuits are then retained for lighting and general purpose receptacle loads. The addition of the new circuits will then require a modification or complete change of the existing local panel in each apartment.

In most cases, branch circuit design will be concerned with two specific loads—air conditioning and kitchen appliances. These are the loads which have most often obsoleted wiring systems in old apartment houses.

Air Conditioning

Inasmuch as the number and size of air conditioning units which may be used in an apartment covers a wide range, provision for this load should be based upon decisions made by the owner during preliminary talks. Typical considerations are as follows:

Room air conditioners are classified as fixed appliances. Section 2126a of the NEC permits operation of a fixed appliance on a 15- or 20-amp, 120-volt lighting and/or appliance circuit if the rating of the fixed appliance does not exceed 50% of the circuit rating. Section 2125a further states that the total load on the circuit shall be only 80% of the circuit rating if a motor-operated appliance (such as an air conditioner) is supplied. These requirements, therefore, limit the size of an air conditioner to ⅓ or ½ ton, i.e. ⅓ or ½ hp: (the numerical value of an air conditioner's rating in tons of refrigeration is for practical purposes the same as its rating in hp). A ½-hp motor has a full load current rating of around 7.5 amps at 120 volts. If it is connected on a No. 14, 120-volt lighting and/or appliance circuit which has two or more outlets, it just meets section 2126a and leaves only 4.5 amps for other loads to make the 80% rating of section 2125a. Because the trend is toward larger air conditioning units, often with resistance heating elements, the use of lighting and/or appliance circuits is not a practical way to handle this load.

Provision of one or more separate circuits for air conditioning is recommended for apartment modernization. A maximum size of unit conditioner should be decided upon with the owner to design air conditioning circuits. Later, tenants should be advised of the capacity of the air conditioning circuits in terms of full-load, nameplate current rating of a unit at nameplate voltage—rather than horsepower or tonnage rating which does not have a fixed conversion to amps and can be a confusing thing to tenants.

Several circuit arrangements are possible for air conditioning, depending upon the characteristics of the service and distribution in the building. Whether there is 2-wire, single-phase 120 volts or 3-wire, single-phase 120/240 volts or 4-wire 3-phase 120/208 volts available in the apartment will determine how far circuit design can go. Three-wire, 240- or 208-volt circuits are preferred since they give the tenant a wider range of selection in buying an air conditioner and, from a design view, they minimize the likelihood of load unbalance. A single 3-wire 240- or 208-volt circuit of No. 12's protected by 20-amp time delay fuses or CB may be terminated at one suitable 240- or 208-volt 3-wire

AVERAGE CIRCUIT LENGTHS (FEET) FOR 1% VOLTAGE DROP

TABLE I. SINGLE-PHASE AC LOADS
115/230 Volts, 60 Cycles, 100% PF

AMPERE LOAD	WIRE SIZE—CIRCULAR MILS					WIRE SIZE—B & S or A.W.G.								
	500	400	350	300	250	4/0	3/0	2/0	1/0	1	2	3	4	6	8
40	1106	898	788	669	558	475	378	299	239	188	150	119	94	59	38
50	885	719	630	535	447	380	303	240	191	150	120	91	75	47	30
60	737	599	525	446	372	317	252	200	159	125	100	79	62	39	
70	632	513	450	382	319	271	216	171	136	107	86	68	53	34	
80	553	449	394	334	279	238	189	150	119	94	75	59	47		
90	493	399	350	297	248	211	168	133	106	83	67	53	42		
100	442	359	315	267	223	190	151	120	95	75	60	47			
110	402	327	286	243	203	173	138	109	87	68	55				
120	369	299	263	223	186	158	126	100	79	63					
130	340	276	242	206	172	146	116	92	73	58					
140	316	257	225	191	159	136	108	86	68						
150	295	240	210	178	149	127	101	80	64						
160	276	225	197	167	140	119	95	75	60						
170	260	211	185	157	131	112	89	70							
180	246	200	175	148	124	106	84	66							
190	233	189	166	140	117	100	80								
200	221	180	157	134	112	95	76								
210	211	171	150	127	106	90									
220	201	163	143	122	101	86									
230	192	156	137	116	97	83									
240	184	150	131	111	93										
250	177	144	126	107	89										
260	170	138	121	103	88										
270	164	133	117	99											
280	158	128	112	96											
290	152	124	109	92											
300	147	120	105												
310	143	116	102												
320	138	112													
330	134	109													
340	130	106													

Calculations based on copper resistance of 12.5 ohms per CM-ft at 50C (122F).

Reactance and impedance losses calculated for each wire.

Conductors closely grouped in metallic conduit.

TABLE II. 3-PHASE DELTA AC LOADS
230 Volts, 60 Cycles, 85% PF

AMPERE LOAD	WIRE SIZE—CIRCULAR MILS					WIRE SIZE—B & S or A.W.G.								
	500	400	350	300	250	4/0	3/0	2/0	1/0	1	2	3	4	6	8
40	710	625	584	530	475	429	364	303	253	208	173	139	113	75	49
50	568	500	467	424	380	343	291	242	203	167	139	111	90	60	39
60	473	417	389	353	317	286	243	202	169	139	115	93	75	50	
70	406	357	333	303	271	245	208	173	145	119	99	79	64	43	
80	355	312	292	265	238	214	182	151	127	104	87	69	56		
90	316	278	259	235	211	191	162	134	113	93	77	62	45		
100	284	250	233	212	190	172	146	121	101	83	69	55			
110	258	227	212	193	173	156	132	110	92	76	63				
120	237	208	195	177	158	143	121	101	84	69	58				
130	218	192	180	163	146	132	112	93	78	64					
140	203	179	167	151	136	123	104	86	72						
150	189	168	156	141	127	114	97	81	67						
160	177	156	146	132	119	107	91	76							
170	167	147	137	125	112	101	86	71							
180	158	139	130	118	106	95	81	67							
190	149	132	123	112	100	90	77								
200	142	125	117	106	95	86									
210	135	119	111	101	90	82									
220	129	114	106	96	86	78									
230	123	109	101	92	83	75									
240	118	104	97	88	79										
250	114	100	93	85	76										
260	109	96	90	81	73										
270	105	93	86	78											
280	101	89	83	76											
290	98	86	80	73											
300	95	83	78												
310	92	81	75												
320	89	78													
330	86	76													
340	83	73													
350	81														
360	79														
370	77														
380	75														

Calculations based on copper resistance of 12.5 ohms per CM-ft at 50C (122F).

Reactance and impedance losses calculated for each wire.

Conductors closely grouped in metallic conduit.

TABLE III. BALANCED LIGHTING LOADS
3- and 4-Wire, 115 Volts 1% drop from supply cabinet to first outlet supplying permanently connected appliance or fixture.

AMPERES (A), WATTS (W), WITH CONDUIT CONDUCTOR (C), FILLS (F)

MAXIMUM OVERCURRENT CIRCUIT PROTECTION	INTERMITTENT LOADS			CONTINUOUS LOADS		
	100% F 2-3 C	80% F 4-6 C	70% F 7-9 C	100% F 2-3 C	80% F 4-6 C	70% F 7-9 C
15 A	15 A 1725 W	12 A 1380 W	10.5 A 1207 W	12 A 1380 W	9.6 A 1104 W	8.4 Amps. 966 Watts
20 A	20 A 2300 W	16 A 1840 W	14 A 1610 W	16 A 1840 W	12.8 A 1472 W	11.2 A 1288 W

LOADS AND LENGTHS IN FEET FOR 1% DROP ON 3 AND 4 WIRE 115 V. CIRCUITS

AMPERE LOAD	#10 WIRE	#12 WIRE	#14 WIRE
1	946	596	374
2	474	298	188
3	316	198	124
4	236	148	94
5	190	120	76
6	158	100	62
7	136	86	54
8	118	74	46
9	106	66	42
10	94	60	38
11	86	54	34
12	78	50	32
13	72	46	28
14	68	42	26
15	64	40	24
16	60	38	
17	56	36	
18	52	34	
19	50	32	
20	48	30	
21	46		
22	44		
23	42		
24	40		
25	38		
26	36		
27	36		
28	34		
29	32		
30	32		

Calculations based on copper resistance of 13 ohms per CM-ft at 60C (140F).

NOTES:

TABLE I:

Balanced 3-Wire Loads: Drop is 1.15 volts for given length.

2-Wire, 230-Volt Loads: Drop is 2.3 volts for given length.

TABLE II:

For 208-volt, 4-wire "Y" feeders multiply given length by 0.9

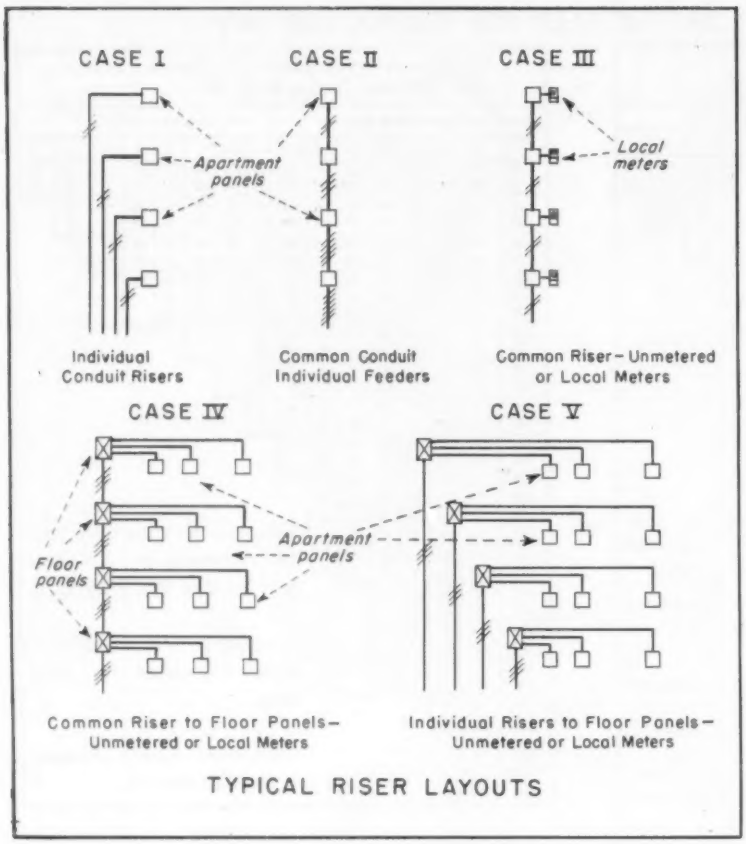
For 230-volt, single-phase feeders multiply given length by 0.85

For 460-volt, 3- or 4-wire feeders multiply given lengths by 2.

For aluminum wire multiply given lengths by 0.7 or use length of copper wire which is 2 sizes smaller than the aluminum size under consideration.

TABLE III:

For 2-phase, 3-wire circuits tapped off a 3-phase, 4-wire "Y" service, multiply given lengths by 0.67.



TYPICAL RISER LAYOUTS

grounding receptacle or may be split-wired to two 120-volt grounding receptacles. The 240-volt outlet can handle a 1½-ton air conditioner; the two 120-volt outlets can each handle a ¾-ton unit. Where only 2-wire, single-phase 120-volt supply is available, one or more 2-wire No. 12 circuits can be used. However a change in service to the building should be considered where only 2-wire, single-phase exists.

Design of individual circuits for air conditioners should conform to requirements for motor circuits, Article 430 of NEC. Particular reference is made to Secs. 4304b, 4309b, 4312 and 4314.

Kitchen Appliances

Code Section 2115b reads, "For the small appliance load in kitchen, laundry, pantry, dining room and breakfast room of dwelling occupancies, one or more 20-amp branch circuits shall be provided for all receptacle outlets (other than outlets for clocks) in these rooms, and such circuits shall have no other outlets."

The wide acceptance of portable cooking appliances—broilers, fryers, coffeemakers—of high load demand has dictated the absolute necessity of at least two 20-amp appliance circuits to provide adequacy and convenience. This recommendation can again be met by installation of a 120/240 or 120/208 3-wire circuit, which is the equivalent of two 120-volt circuits. Three No. 12 conductors (minimum size for adequate wiring) are used with duplex receptacles split-wired between neutral and hot legs. This setup increases capacity at each outlet and minimizes voltage drop in the circuit. All receptacles on 20-amp appliance circuits should have grounding contacts and be able to receive a standard two-prong plug cap. Whether or not one 3-wire or two 2-wire 20-amp circuits is enough capacity for a particular apartment can be determined by studying load conditions. Take the apartment which has the most and biggest kitchen appliances; add up the kw ratings of all of these appliances; then divide this kw total by 2000. The answer, evened-off to the next whole number, is the number of 20-amp circuits which represents good circuit design with ample reserve capacity.

General Purpose

Depending upon the economic limitations of the particular job, modernization of general purpose lighting and receptacle circuits may be included. When existing branch circuits have been cleared of all appliance and air conditioning loads, they may be appraised for their ability to provide modern lighting capacity and convenience in use of receptacles for floor and table lamps, radio, television, vacuum cleaner.

The combined lighting and non-kitchen appliance load in a typical apartment can no longer be considered adequately served by an installation meeting minimum code requirements of 3 watts per sq ft and one receptacle outlet for every 20 linear ft of wall length.

Circuit loading has increased greatly as a result of a new awareness of the value of good lighting. Current interior design features bright, well-lighted rooms with more lighting equipment of higher wattage ratings, such as the 3-way 150- and 300-watt lamps. Another boost in load on general purpose circuits is assured with the impending arrival of color television which will demand around 700 watts. Portable electric heaters, sun lamps, fans and similar equipment are loads which aggravate the situation.

Recommended standards for general purpose circuits are as follows:

a. Provide one 20-amp. 120-volt circuit for each 500 sq ft of floor area or one 15-amp, 120-volt circuit for each 375 sq ft.

b. Maximum distance between convenience receptacles should not exceed 12 ft.

c. Provide separate branch circuits for lighting and for receptacle outlets in living rooms and bedrooms.

d. Use 3-wire circuits for receptacle outlets with receptacles split-wired.

Circuit Protection

Installation of new circuits will require modification of the existing arrangement of local panels in apartments or sub-feeder panels on the individual floors. Proper fuse or CB protection must be provided for new circuits. New local and/or floor panels will have to be installed depending upon the general distribution plan to be used.

Distribution

Design of a distribution system to serve the modernized branch circuit

apartment loads should actually have begun during the pre-work electrical survey. The method of existing distribution should have been carefully noted and kept in mind during design of circuit wiring. In all apartment house modernization, the redesign possibilities of both circuits and risers are completely interlocked and should therefore be considered together. After the circuit layout for apartments is completed, the existing distribution system must be revised—altered, enlarged and, if necessary, basically changed—to dovetail with the new circuiting.

Layout of the existing distribution system in any apartment house indicates the range of possibilities for modernization. The method of metering, if it is to be retained the same, must be considered in designing modernization of risers. If each apartment is individually metered in the basement, that is one situation. If local meters are used for apartments or if individual metering is not used, other possibilities are presented.

Method of existing distribution also figures in redesign. Apartment panels may be served by: individual feeders in individual conduit runs from meter banks in basement; individual feeders in common conduit riser; taps into a common feeder in a common conduit riser; subfeeders from a floor distribution panel which may, in turn, be supplied by any of the foregoing methods.

The use of feeders to floor panels and subfeeders to apartments or the use of taps from apartment panels into a common feeder is limited to those cases where there is no individual metering or there is local metering.

Article 220 of the NEC covers calculation of feeder sizes. A very important fact about all of the 1953 code is that requirements are far more detailed and involve much higher minimum capacities than did the code of 20 or 30 years ago. What was code minimum then would be serious violation now. Although the new code provides much greater adequacy than did the old, it should be remembered that even the present code is only a safety standard. Spare capacity in wire and conduit sizes should be considered and designed into the modernized system wherever possible. Example No. 4 in chapter 10 in the back of the NEC book illustrates typical design calculations for apartment houses, pointing up the procedure for calculations of minimum requirements to which reserve capacity can be added.

Another design consideration in modernization of the distribution system is the metering arrangement. The various possibilities on this should be discussed with the local utility to determine if new meters are necessary and how they might be laid out, depending upon service setup.

Service

To supply the modernized electrical system in the apartment house, the service setup must also be modernized. This will mean new service entrance conductors and new service entrance equipment.

For the service setup, a wide range of redesign alternatives exist. Old fused service switches can often be used as sub main disconnects and protection; old cabinets can be modified to take new switches; a separate service can be brought in for those cases where the modernized risers and circuits have no tie-in to existing wiring. Article 230 of the NEC makes possible many other revisions of service setup.

STEP 3 - INSTALLATION

In modernizing apartment houses, as in all electrical modernization, actual installation work presents the only real problems. Installation involves the dovetailing of new with old equipment to accomplish design objectives. The work is complicated by the fact that so much of the system is concealed and/or unknown to the contractor. The following sections cover typical practice of electrical installations on modernization jobs, offering practical solutions to common problems.

One of the most important considerations in rewiring existing structures is that the NEC provides for modernization and expansion. Secs. 3466b, 3486 and Tables 11, 12 and 13 cover rewiring of existing "raceways"—rigid metal conduit, flexible metallic conduit, EMT, underfloor raceways, wireways, busways and auxiliary gutters. Any existing raceway for circuits, sub feeders, risers, sub mains or mains can be rewired to 50% fill of the raceway's cross section area. By utilizing the greater permissible area of conduit occupancy, substantial increase in power capacity is possible without changing or adding raceways. Thin-

REWIRING EXISTING CONDUIT FOR 50% OCCUPANCY WITH TW WIRE

	3-Wires in Conduit	4-Wires in Conduit	6-Wires in Conduit	8-Wires in Conduit
Cond. Size	Max. Size Wire	Max. Size Wire	Max. Size Wire	Max. Size Wire
½"	#8	#10	#10	#12
¾"	#6	#8	#8	#10
1"	#4	#6	#8	#8
1¼"	#1/0	#2	#4	#6
1½"	#3/0	#1/0	#2	#4
2"	300M	#4/0	#2/0	#1
2½"	400M	300M	#4/0	#2/0
3"	750M	500M	300M	#4/0
3½"	1000M	750M	400M	300M

IMPORTANT: — All calculations based on 90% power factor.
— Mechanical factors may not permit 50% occupancy.

wall-insulated wires offer less cross-section area than do rubber-covered wires of same current carrying capacity. This again affords an increase in system capacity, within the limitation of existing sizes of raceways.

Circuit Wiring

The crucial problem in modernization of the electrical system within apartments themselves is extension of new circuits to various points of utilization.

The first and easiest method, to be used wherever possible, is to run the circuits in existing raceways. For example, consider a case where a circuit is to be run to a new outlet for air conditioning in the bedroom. These new conductors would be pulled in an existing conduit from the fuse panel to the nearest existing base outlet in the bedroom, then extended to the air conditioning outlet in a new raceway.

Two techniques are generally employed for rewiring existing raceways. The first is to tie the new wires to the old and use the old conductors to pull in the new ones. This method is efficient only when the length of the run is short, conduit bends are limited, and the number of wires is small in relation to the capacity of the conduit. The safer and usually faster way is to fasten a wire snake with a swab to the end of the original circuit wires, pulling these through the raceway as the old conductors are removed; then pull the new wires in with the snake. This system assures the removal of any foreign matter which may have accumulated and, since the frictional resistance of the old wires is not present, the force required to pull in the new conductors is smaller. These benefits are important because they reduce the possibility of tearing the plastic insulation of new TW wires and they cut down labor fatigue.

All existing wires in the raceway *must* be replaced even if only one additional conductor is being installed in the conduit. It is a good practice, moreover, to remove all existing wires in any installation more than 20 years old.

Where new conduits are needed, the most economical answer is afforded by surface metal raceway. One type of surface raceway featuring prewired receptacles spaced at 6-, 18-, or 30-in. intervals is very convenient to install where additional base outlets are required.

In some cases, the additional wiring must be concealed. Armored cable is preferred for this purpose as it usually can be fished in without chasing the plaster along the entire length of the run; moreover its small outside diameter simplifies its installation in tight furred spaces. Greenfield can be used where the number of necessary conductors exceeds the limitations of armored cable or where provision for future rewiring is desirable.

Methods of installing concealed raceway, whether flexible conduit or armored cable, are determined by the structural design of the ceiling, walls and floors. Unless the original construction plans are available, the mechanic must cut through the plaster and determine the type of construction to discover whether new raceways can be fished in behind the finishing or if it will be necessary to chase out a channel in which to embed it. In some cases, where wire screen lathing has been used and there is little or no furring space behind it, concealment of a new raceway may be virtually impossible from the standpoint of labor cost. The accompanying table lists the construction features and raceway installation techniques for several of the most common types of ceiling and wall design used in apartment houses. It must be noted that while these descriptions are accurate within their scope, many variations of each design have been used. The contractor should therefore check each structure thoroughly to avoid costly errors in his work plan.

Beside rewiring existing conduits and installing new ones, one other special problem is encountered in modernizing the circuit wiring system of apartment buildings—how to mount the new fuse or CB panel?

Except where the new wiring is completely independent of the existing system, the panel must be placed close by the old fuse box in order to make use of existing feeder and branch circuit raceways. Most common locations for these panels are the kitchen or the entrance foyer, often behind the position of an open door and still more often, particularly in older buildings, the box may be mounted at a height of 66 to 72 inches. In such cases the simplest answer is to surface-mount the new panel on the old box after removing the interior of the original panel. Where it is required that the new panel be recessed, the old box should be left in place and the new one mounted alongside, above, or below it. This avoids costly labor involved in adapting existing raceway terminals to the new box.

Distribution and Service

The problems which arise in the installation of a modernized apartment house distribution system are basically the same as those encountered in renovating the circuit wiring: rewiring existing raceways; installing new raceways; and mounting and connecting new panels (and meters). Because the equipment is larger, heavier, and more complex, however, the achievement of practical solutions is even more important to the financial success of the job.

Techniques for pulling feeder cables in new conduits may generally be applied to rewiring jobs as long as certain special conditions are considered first. For example, it can be expected that pulling will be a lot more difficult since the area of the conduit occupied by the cables will usually be close to 50% in a modernization project, whereas on new work the maximum permissible fill is 40%.

Greater care must therefore be taken to avoid tearing the plastic cable insulation which is used for this type of work because of its smaller outside diameter. It is again recommended that the existing conductors be used to pull a conduit swab and a snake into the conduit before the new cable is introduced. This minimizes frictional force on the new conductors and removes damaging obstructions from the raceway.

On long, tight pulls where pull boxes have been used in place of elbows, it is advisable that separate pulls be used for each run of conduit. Thus, for an 80-ft riser conduit with a right angle pull box at the mid-point, the required three or four 80-ft lengths of cable would be pulled through the first stretch of conduit, then the extra 40-ft would be pulled into the second conduit run. A variation of this is to pull in both directions from the pull box, but this is not generally efficient since it involves more frequent relocation of reels and power winches.

Another means which has been found effective in cutting labor involved in rewiring apartment risers is the use of battery- or sound-powered phones between the feed and pulling points. Lines can be dropped from

TECHNIQUES FOR CONCEALING FLEXIBLE RACEWAYS IN TYPICAL EXISTING STRUCTURES

	Furred	Type of Lath	Construction Features	Direction of Run	Suggested Installation Methods
Ceilings					
Wood beams	No	Usually wood Wire screen in newer bldgs	Diagonal braces every 10-20 ft	Parallel to beam	Fish through hand holes broken in plaster at both ends of run — additional holes cut in at obstruction points.
				Perpendicular to beam	Best way is to take up floor above ceiling. Otherwise chase ceiling along entire length of run, cutting lath and plaster with keyhole saw. Drill beams at least 2 in. from edge. Labor very high. With wire lath, this operation is prohibitively high in cost.
Dropped beam concrete	Yes	Usually wood hung from iron straps	Ceiling level set at lower edge of beams. Plenum space ends at beams.	Any	Fishing in plenum space is simple. Crossing under beams is the problem. Unless plaster finish on beams is thick enough to conceal conduit, surface raceway is the only recourse.
Flat pan concrete	No	None	Plaster finish applied directly to slab.	Any	Chase ceiling or drill slab and run through sleepers on floor above if sleepers project above slab. Both methods are extremely costly.
Walls					Simplest means is to remove wooden baseboard. Switch legs can be installed by cutting hand holes and fishing in behind metal door frames.
Hollow tile block	No	None	Mortar obstructs hollow spaces in block.	Any	There is no possibility of fishing in flexible raceway and chasing tile is dangerous since large pieces break off easily.
2 by 4 wood studs	No	Usually wood Wire screen in newer buildings	Studs on 16-in. centers. Horizontal braces placed at random.	Vertical	Cut hand holes and fish. Additional holes required if brace is encountered. Notch 2 by 4 header to enter ceiling.
				Horizontal	If base mold cannot be used, channel plaster and drill studs (expensive). With wire lath, cost is prohibitive. Best bet in any case is surface metal molding.
Brick	Yes	Wood	Wood furring about 1-in. deep runs vertically.	Vertical	Cut hand holes and fish behind lath.
				Horizontal	Channel plaster and cut furring strip with keyhole saw; short runs only.
Steel studs (non-load bearing partitions)	No	Wire screen	Studs vary in depth from 1 to 4 in. No standard spacing of studs.	Vertical	Cut holes in plaster and lath (use tin shears) and fish.
				Horizontal	Truss arrangement of deeper type studs may permit horizontal fishing.
Cinder block	Yes	Wire screen	Metal channels or wood may be used as furring. Depth of furring varies.	Any	Block can be chased but wire lath too expensive to cut. Vertical runs may be fished where furring is deep enough.

the apartment window then carried through the basement to the distribution point. This quick and efficient communication between both elements of the wiring team coordinates efforts and avoids delays which occur so frequently in this type of work.

New Raceways

The most serious obstacle to economical modernization of multiple-dwellings is the lack of sufficient raceway capacity in the risers to bring feeders up to adequacy. Installation of new vertical conduits is slow, tedious, and expensive; but there are a few tricks which can substantially reduce the cost of the item. Since the major portion of labor involved is attributable to cutting and patching walls and floors, the contractor should look for a free way up through the building.

Where heavy feeders are used with distribution panels in the halls of the upper floors, the problem is narrowed down to cutting a few large holes in the floors of the electric closets. Horizontal raceways from these panels will seldom need augmenting since as high as three No. 8 or eight No. 12 thermoplastic wires can be pulled into a ½-in. conduit according to Table II, Chapter 10 of the NEC.

Feeders rising vertically into the individual apartments present a more difficult problem. The best solution is found where the structure contains dumbwaiter shafts. The swing to *self-service* supermarkets has so outmoded the dumbwaiter as an essential to apartment dwellers, that both landlord and tenants will generally be agreeable to releasing it for use as an electric riser shaft. Since both the dumbwaiter and the fuse panel are usually located in or near to the kitchen, lateral runs in the apartments can be kept to a minimum.

In cases where the new distribution is concerned only with supplying window air conditioning units, it may be found expedient to run vertical conduits up the outside of the building.

In the two preceding situations, the entire run of conduit can be made-up from the ground level. The method is to fasten a threaded eye bolt to the first length of conduit then run a rope through the eye and up to a man at the top of the shaft or on the roof; if preferred, a pulley-arrangement can be used at the upper level and the rope doubled back to the base point, the conduit is pulled up high enough to permit another length to be coupled onto it, then the process is repeated until the prescribed length is obtained. Conduit fittings can be inserted in the run at predetermined points while making up the conduit. Fastening conduits, tapping risers, and covering boxes are accomplished from openings in the shaft, or for outside work by mechanics using window cleaner's safety belts at each floor. Occasionally, however, it may be necessary to use a boatswain's chair for this work.

Where building codes do not allow conduits to be run on the exterior of a building, an air conditioning feeder system can often be installed by fishing flexible metallic conduit into the furred space on the outside walls. Most buildings include this construction feature to protect plaster from moisture. Baseboards are removed to permit drilling the slab or header, then a chain is dropped through the hole and picked up at the next lower baseboard. The chain is then used to pull in Greenfield. This technique has been employed successfully to install vertical feeders for the entire branch circuit system in buildings with furred interior partitions. It should be noted that any new raceway installed on a modernization job is exempt from the provision for 50% conduit occupancy.

Extension of new lateral raceways in the basement can be accomplished expeditiously with wireway. NEC section 3624 permits up to 30 light and/or power conductors in a duct providing their aggregate cross-sectional area does not exceed 20% of the wireway's interior area. This code provision makes wireway particularly useful for running multiple feeders through the basement to the locations of new vertical riser conduits.

Distribution Equipment

In most prewar apartment buildings having basement metering, the feeder protection consists of a row of porcelain 30-amp plug fuse cutouts mounted in an oblong metal box with a hinged cover. Most common location of this equipment is above the meter bank. Where the new apartment feeders do not exceed 50 or 60 amps it is often possible to install the appropriate size of cutout or circuit breaker in the existing box. Whether or not 60-amp gap cutouts can be used will depend on the dimensions of the box in question, but 50-amp CB's, mounted side by side will almost always fit. Several manufacturers now offer a mounting strip for such applications of breakers. The contractor merely has to cut a slit in the box cover to accommodate the breaker handles and adapt the hinged-cover for screw fastening.

In cases where it is not practicable to employ the existing fuse box for the new protective devices, the old panel can be used as a pull or splice box, with wireway connection to the new distribution panel.

There are, of course, many different arrangements of distribution equipment to be encountered by the contractor doing modernization work. More often than not the equipment will be so inadequate and so outmoded that it requires complete replacement. This condition brings forward the problem of shut downs.

If space is available to mount the new equipment on a wall adjacent to the existing panels and meters, the problem is not too difficult. Otherwise it is necessary to resort to some expediency such as constructing a wood partition and mounting temporary equipment on it or even bringing trailers in from a nearby building.

The key to quick and economical modernization of service and distribution of apartment houses is found in a combination of careful planning and scheduling, up-to-date equipment, and prefabrication of elements wherever possible. Basically the operation breaks down into five parts:

1. Lay out the system using modern, easily installed components such as ganged, socket meter troughs and wireway.
2. Prefabricate new main and submain raceways and cables to proper dimensions; pre-assemble enclosures and components where possible.
3. Mount as much of the new equipment as is possible without disturbing service continuity.
4. Provide necessary jumpers, switches, etc., to maintain required temporary service during changeover.
5. Mount and connect new equipment.

Conclusion

The tremendous market potential for apartment house modernization presents a challenge to the enterprising electrical contractor. Enormous profits await any man willing to develop an aggressive selling program, and to assemble and train engineering and field forces which are equipped to handle with efficiency the special problems of modernization work.

Two Ways to Increase

Farm Electric Service Entrance

by mounting 200-amp service equipment under meter on yard pole for overhead and underground distribution systems.

THE yard pole is generally the hub of a farm electrical distribution system. The actual service entrance to the farm property is located at this point. Equipment on the pole consists of a service drop, meter socket, main disconnect means, separate switch for water pump circuit, and grounding facilities. Circuits, either overhead or underground, radiate from the pole to the farm buildings.

A majority of farm installations at present have either a 60-amp or 100-amp yard-pole disconnect switch which, in most cases, is inadequate for even present loads. With the anticipated increase in farm electrical loads, these services must be enlarged to take care of the necessary farm production equipment as well as household appliances. The trend is to recommend 200-amp yard-pole service facilities to handle present connected loads and provide ample spare capacity for future electrical loads and expansion.

Two yard pole arrangements of 200-amp service capacity are shown in Figs. 1 and 2. These are recommended by the Rural Development Department, Northern States Power Company, Minneapolis, Minn. and approved by the Minnesota State Board of Electricity and Fire Underwriters' Inspection Bureau in that area. Both designs are similar down to the meter socket. Beyond that they differ depending on whether distribution is to be overhead or underground.

Overhead Distribution

Service facilities for an overhead distribution system are detailed in Fig. 1. The service drop comes down to a 200-amp meter socket, then to a 200-amp raintight, fused disconnect switch. The 3-wire service continues, from the line side of the switch, up the pole in conduit to a point where overhead distribution conductors from various farm buildings terminate. A separate, 30-amp, fused, raintight switch connected to the line side of the main disconnect controls the water pump circuit.

The system is grounded by means of a mechanically protected wire from the disconnect to a driven ground rod at the base of the pole.

Underground Distribution

The recommended yard-pole arrangement for underground distribution is shown in Fig. 2. Here the service drop and meter socket are similar to that in Fig. 1. But the main disconnect switch is replaced by a 200-amp circuit breaker or fused-switch panelboard to provide up to six individual circuits.

One of these circuits would serve the water pump and the operating handle of the circuit breaker or switch should be painted a bright color for easy and quick identification. The other five circuits would feed the farm house and other buildings.

With this type of panel, incorporating overcurrent protection for each of the six circuits, type UF (Underground Feeder) direct burial cable can be used for underground distribution. Cables leave the bottom of the panel and are protected by conduit sleeves until they enter the trench. Type USE (Underground Service Entrance) cable, sometimes referred to as Type RR Trench Cable, may also be used if desired.

This system is grounded in the same manner as the overhead arrangement with a mechanically protected ground wire connecting the panel with a driven ground rod at the base of the yard pole.

These are just two of a number of possible methods of installing farm electric service entrance equipment. Whatever method you may use in your design, it is advisable to check with the local utility representative and electrical inspection authority before proceeding with the installation.

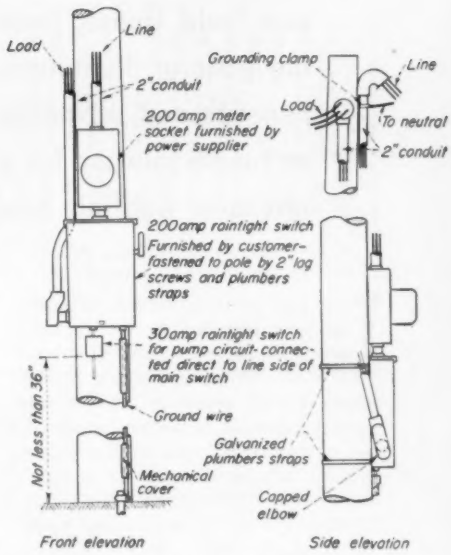


FIG. 1—For overhead distribution, yard pole service entrance arrangement incorporates a 200-amp main disconnect switch under self-contained meter socket, plus separate raintight switch for pump motor circuit.

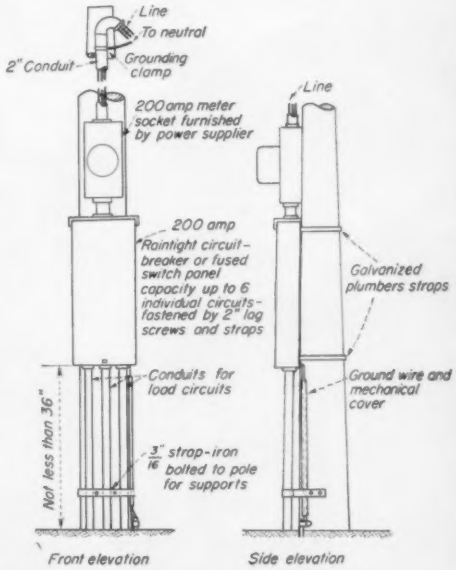

Line
To neutral
2" Conduit
Grounding clamp
200 amp meter socket furnished by power supplier
Line
200 amp Raintight circuit- breaker or fused switch panel capacity up to 6 individual circuits- fastened by 2" lag screws and straps
Galvanized plumbers straps
Conduits for load circuits
Ground wire and mechanical cover
Not less than 36"
3/16" strap-iron bolted to pole for supports
Front elevation
Side elevation

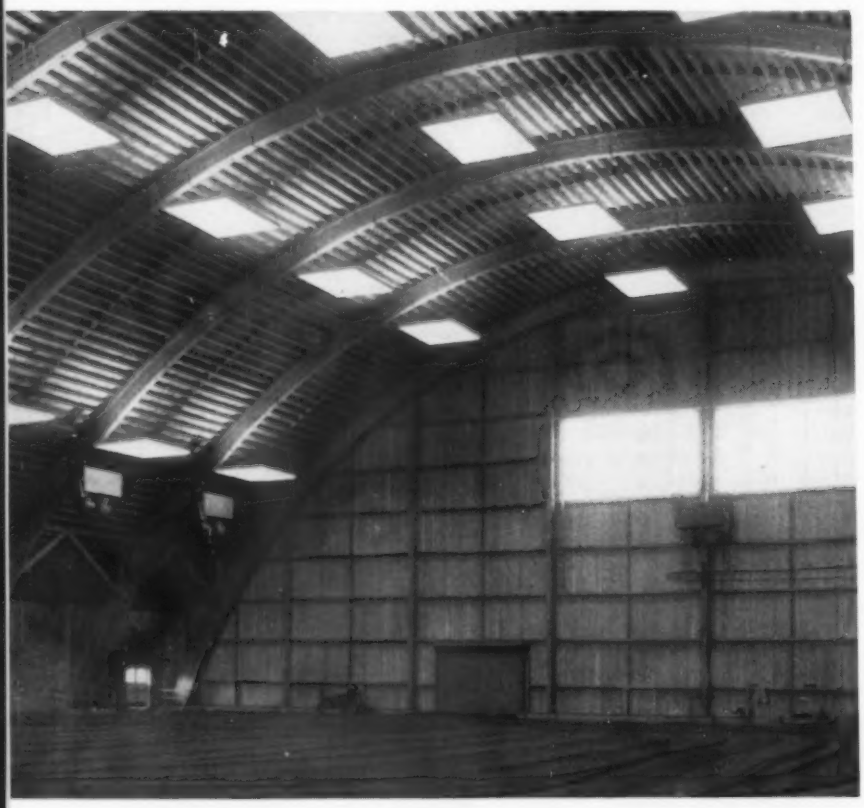
FIG. 2—For underground distribution, circuit breaker or fused-switch panel with up to six circuits can be mounted on yard pole. One clearly identified disconnect is used for water pump circuit.

Hi-Cycle Lighting Comes of Age

Union College installs high-frequency fluorescent lighting system in its new Field House, finds it efficient, economical, and practical for providing general illumination in large, high bay area. Analysis of its many benefits and advantages, and present status of development reveals it as timely solution for growing new market for better quality and higher intensity lighting now shaping up.

By Berlon C. Cooper

THE new lighting system designed for and installed in the recently completed new Alumni Memorial Field House at Union College, Schenectady, N. Y., represents another important milestone in lighting progress, and a further advance in fluorescent lighting development. It is a high-frequency, high-voltage fluorescent lighting system incorporating many new lighting and electrical techniques, and is the nation's first large-scale application of high frequency for the general lighting of a large area. It was purchased by Union College strictly on its merit for providing higher lighting levels of comfortable non-glaring illumination more economically than conventional 60-cycle systems, according to T. R. McIlwaine, Union College business mgr.

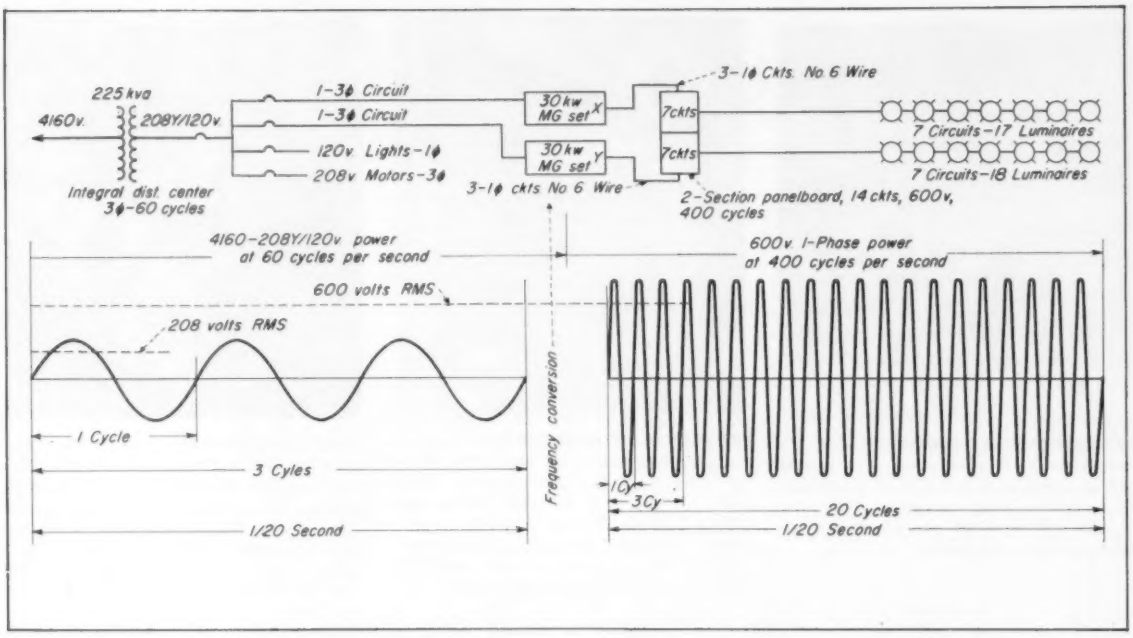


HIGH-FREQUENCY operation of fluorescent lamps in large, low-brightness luminaires provides high level of general illumination in Alumni Memorial Field House, Union College, Schenectady, N. Y., in first practical application for a large area.

This new and advanced lighting system consists essentially of three parts: 1) a rotary-type frequency converter which acts as both a transformer and a frequency changer; 2) a high frequency distribution system; and 3) large-area, low-brightness, special design luminaires installed in accordance with a planned lighting layout. The principal advantage of the resulting overall system over a conventional 60-cycle lighting system is that it produces more light at less cost, while offering many other inherent benefits which a detailed analysis of the Union College installation as presented here will reveal.

Frequency Converters

Two frequency converters of the rotating-type are used to supply power to the luminaires at higher frequency and higher voltage than is used on conventional power systems. Each has a rated output of 30-kw. at 80% power factor. Each is assembled as a packaged unit and contains a 45-hp, 208-volt, 3-phase, 60-cycle motor and a 30-kw, 3428-rpm, 600-volt, 3-phase, 400-cycle generator. Also included as part of the self-contained unit are input and output fused disconnect switches, a motor starter with push-button, a Regohm regulator and a voltmeter. The unit is housed in a steel housing which is 44 inches high, 56 inches long, and 21 inches wide. The entire unit weighs approximately 1500 pounds. Two converters were used deliberately, in lieu of one larger unit, in order to insure continuation of light during infrequent maintenance periods.



ELECTRICAL SYSTEM supplies 60-cycle power to Field House at 4160 volts, 3-phase primary, 208Y/120 volts secondary. The motor-generator sets convert 60-cycle power to 400 cycles at 600 volts for general lighting.

The two converters are designed for close regulation of voltage and frequency, to insure starting of the slimline lamps at impressed circuit voltages and without the use of autotransformers in the ballasts. Thus generator output voltage is regulated to limits of plus or minus 5%, and frequency to limits of plus or minus 3%.

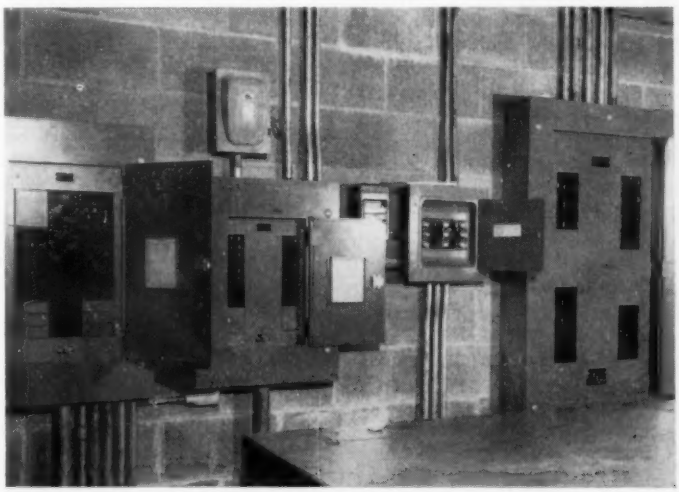
The standard 3-phase generators of each converter had to be modified so that branch circuit utilization voltages would meet requirements of the National Electrical Code. It was desirable to distribute 600 volts direct to the slimline lamps so that a simple choke coil or capacitor would serve as a ballast. The Code requires that the maximum voltage not exceed 300 volts to ground. So the mid-point of each phase of the 3-phase generator was brought out to a terminal block and grounded. Then each of the individual phases were treated as single-phase circuits mid-tapped to ground, which provided 600 volts across phase wires and only 300 volts to ground from either phase wire. Details of this hookup are shown in the generator wiring diagram (on page 83).

Power Distribution System

Standard 60-cycle power is supplied to the Field House at 4160 volts, 3-phase, 4-wire, where it is transformed to 208Y/120-volt, 3-phase, 4-wire, 60-cycle power in a 225 kva integral distribution center. This center supplies 120-volt single-phase secondary power to the utility lighting circuits in the basement and locker rooms, and 208-volt, single-phase and 3-phase secondary power to miscellaneous motors used in the heating system and elsewhere. Two of these 3-phase, 3-wire, 208-volt circuits supply power to the frequency converter units. Standard design and standard equipment were used for the 60-cycle power distribution.

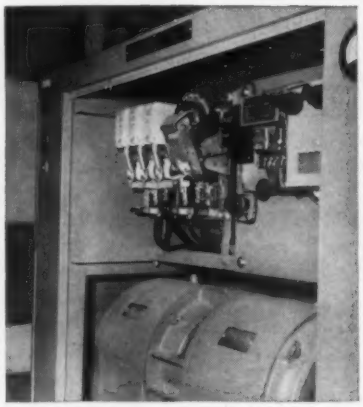
The 400-cycle power from the converters is distributed through a 2-section 14-circuit panelboard, thence over branch circuits run in steel conduit to point-of-use at individual luminaires on the ceiling, terminating in 3-pole convenience outlets. Type S 3-conductor flexible cord connects the lamps in the luminaires to the convenience outlets and provides for positive grounding of the luminaires by means of the third wire.

The panelboard is divided into two sections by means of a metal barrier which prevents a fault in one section being communicated to the other sec-



DISTRIBUTION SYSTEM includes 400-cycle, 600-volt branch circuit panelboard (at right) for general high-frequency lighting. In right foreground is "packaged" M-G set.

BRANCH CIRCUIT CONDUITS were installed on bottom of wood arch beams before arches were crane-lifted into place. Four ¾-in. steel conduits carry the branch circuits from the panelboard to the individual roof arches.



FREQUENCY CONVERTER is of rotating type, self-contained in 44-in. by 56-in. by 21-in. metal housing, with 45-hp 208-volt, 3-phase, 60-cycle motor, and 30 kw 3-phase, 600-volt, 400-cycle generator. Unit also serves as a transformer, includes direct-coupled exciter, and 208-volt contactor with overload relays.

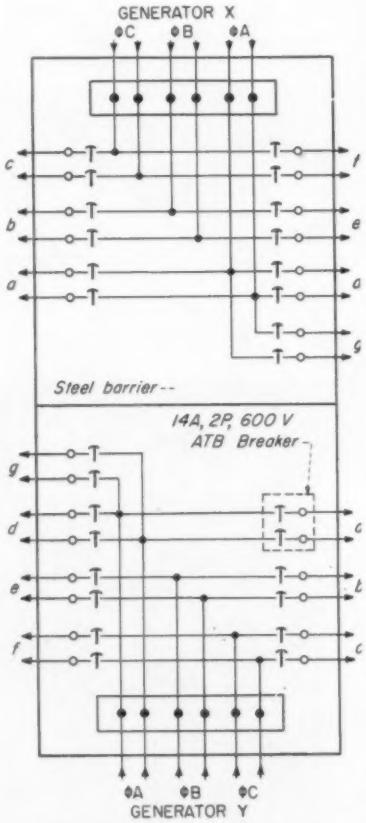
TWO CONVERTERS supply 400-cycle power to 490 96T12 instant-start fluorescent lamps in 35 luminaires, operated at 600 ma, 600 volts. John H. Campbell, General Electric illuminating engineer, who developed the high-frequency fluorescent lighting system, is pushing the "starter" on one of the two 30-kw units.

tion. One section is fed by one of the frequency converters, and the second section by the other. Each section contains seven Type AT circuit breakers, which are fed by three 600-volt single-phase circuits from the generator feeding that section. No. 6 wire is used for these three circuits. Each panelboard circuit breaker controls a separate branch lighting circuit, consisting of a pair of No. 12 wires, to which are connected either two or three luminaires. Each luminaire load is approximately 2.3 amps. Therefore each branch circuit carries 4.6 amps when it serves two luminaires, and 6.9 amps when it serves three luminaires.

The 14 pairs of No. 12 wires feeding the 35 luminaires are run in four ¾-in. steel conduits from the panelboard to the individual roof arches, and from there to the luminaires in ½-in. steel conduits. Inductive reactance losses and voltage drop are not a problem at the high frequency, as might be assumed without careful analysis of all the factors, due to the small magnitudes of current involved and brought about in part by the high distribution voltage of the branch circuits. The 35 luminaires are laid out in five rows of seven units per row, and then connected to the branch circuits so that alternate units are on the same circuit, and so that with either generator in operation the entire area will be uniformly lighted.

Lighting Layout

The Field House is 209 ft 6 in. long by 198 ft wide, covered by an arched roof. Height of the roof at the center is 66 ft above the playing floor. Proposed sports activities include baseball and football practice, basketball, track



PANELBOARD for 400-cycle branch circuits is standard 2-section Trumbull unit, with seven Type AT 15-amp breakers in each section. One generator serves top section, one serves other section.

events and miscellaneous recreational activities.

Since this interior is a large, high-bay area, the first tentative lighting layout was based on a combination of incandescent and mercury lamp high bay reflector units which has been considered standard practice and suitable generally for this application in the past. It was recognized, however, that in playing baseball the glare from the bright filament and mercury lamps would be undesirable, and particularly so for fly balls, and would be less than ideal for some of the other sports.

Conventional 60-cycle fluorescent lighting was next considered for this area, but was finally rejected because of the height and shape of the structure interior, which presented obstacles to the use of continuous row equipment. Then the idea of using a number of large luminaires, each containing as many lamps as required for the lighting intensity needed, was considered. This idea seemed practical from a lighting standpoint, but had the disadvantage of excessive weight due to the large number of heavy ballasts that would have to be supported in each luminaire, plus the fact the cost was greater.

The use of a high frequency electrical system made it possible to design a relatively lightweight luminaire, which would be sufficiently large in area to provide low surface brightness, and still high enough in lumen output to light the playing area to the desired high level of illumination needed for the proposed sports activities.

Seven of the nine wood arches

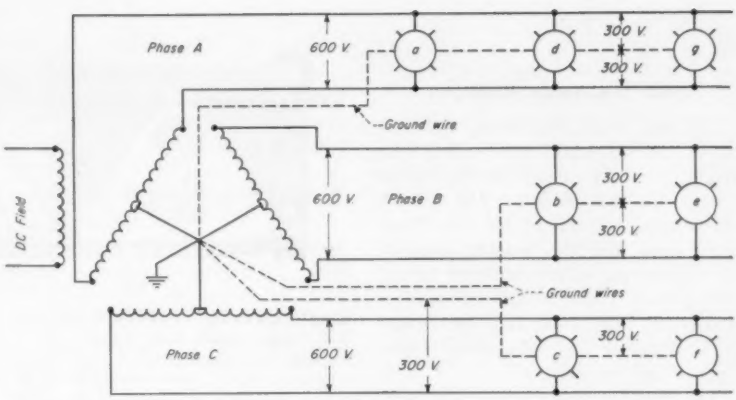
which support the curved roof were used for mounting the luminaires. Calculations indicated that 35 of the special luminaires, each equipped with 14 slimline lamps and operated at 600 ma to provide 6000 lumens per lamp at 400 cycles, which could be done on a practical basis, would provide an estimated 46 footcandles maintained in service. This was considered a satisfactory design objective. Therefore the lighting layout finally approved consists of five rows of seven luminaires per row. Units installed in the center row are 60 ft above the floor, and the two outer rows are 34 ft above the floor.

The five luminaires on each arch are connected to two separate circuits, two units on one circuit and three units on the other circuit. Each of these two circuits are then fed from separate generators, and the load between the different arches is in turn divided so that one generator supplies 400-cycle power to 17 luminaires and the other generator supplies the other 18 luminaires. The branch circuit connections are shown in the lighting layout plan. This arrangement insures approximately half of the design level of illumination with only one generator turned on.

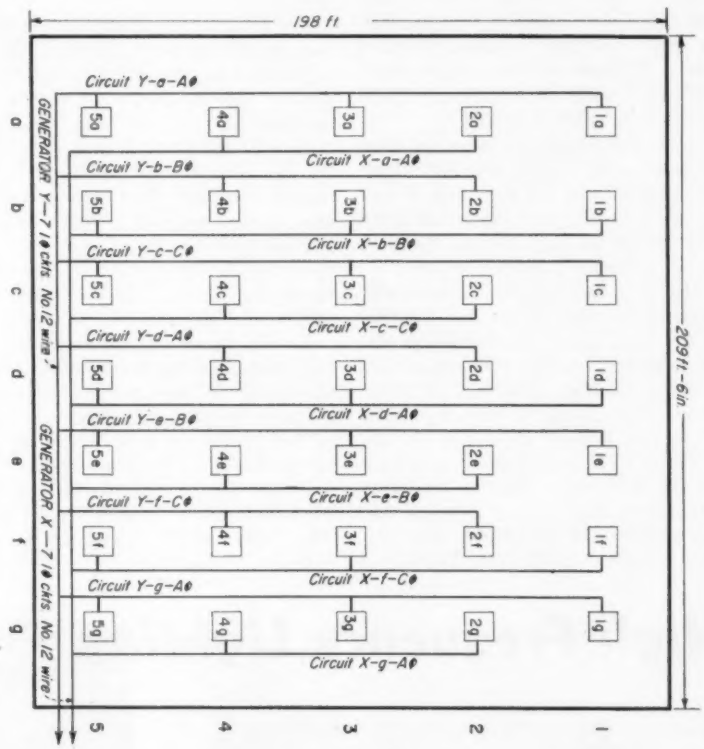
Luminaires

The luminaires were custom designed for this installation by Carl J. Allen, G-E school and indoor sports lighting specialist, who also made a prototype model of the unit for test and study. They are approximately 8½ ft square and 5½ in. deep. Each luminaire contains 14 slimline lamps, Type 96T12, spaced 8 inches on centers. Half of the lamps are controlled by choke coil ballasts, weighing only two pounds, while alternate lamps have capacitor ballasts weighing only three ounces. The luminaire is designed with a separate compartment at one end of the lamps which serves as a wireway and houses the ballasts. The combination of choke coils and 0.4 mfd capacitors provides unity power factor for each branch circuit. Light output for the 14 lamps is 84,000 lumens, but is obtained at a very low brightness relative to the light sources. Luminaire reflectors are made of aluminum and V-shaped, open at the top to permit an upward component of light which illuminates the ceiling softly and reduces contrast between the lighted luminaire and the ceiling above it. Each luminaire is also equipped with a diamond mesh wire guard, made in two sections, which completely covers the bottom of the units to protect them from fly balls or other objects from the playing field. The guard has a 2½-in. by 4-in. diamond pattern, and is made of ⅛-in. diameter steel wire attached to a ¼-in. diameter wire around the outer perimeter. The two sections of guard are hinged separately, either from center or outer edge of the luminaire, affording easy access to unit.

Each luminaire is supported from two double hooks attached to the arched truss, by means of welded link steel chains which attach to eyehooks in each corner of the luminaire. The luminaires were made by Curtis Lighting, Inc. of Chicago, and shipped to the job unassembled due to their size and shape. The units were assembled on the job.



CONVERTER OUTPUT is 3-phase, 600-volt, 400 cycles, with each phase winding midtapped to ground to meet NECode requirements of 300 volts maximum-to-ground. Each converter supplies power to seven circuits.



LIGHTING LAYOUT for 41,500 sq ft interior of Field House consists of 35 luminaires in five rows of seven luminaires per row. Luminaires are connected with alternate units on same generator circuit to provide uniform lighting of entire area from either generator circuit.

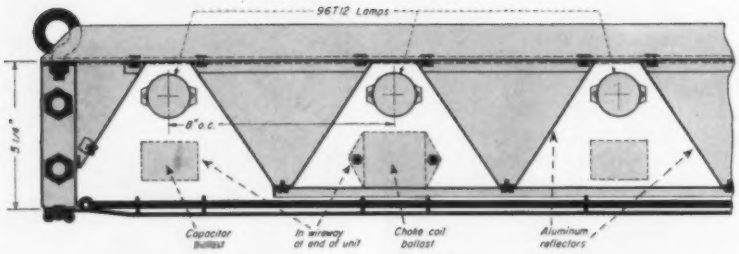
Other Installation Highlights

The new Field House cost approximately $475,000 and was paid for in large part by contributions from Union College alumni. The school, oldest college chartered by New York State, was also the first to combine an engineering course with its liberal arts school. Now, it has set another important "first"—the first installation of a complete high-frequency, high-voltage lighting system.

The frequency converters used in this lighting installation are modifications of similar units developed for and supplied to the U. S. Air Force for supplying 400-cycle power for a wide variety of applications. Modification included changing of generator output from its standard 3-phase power to three separate single-phase, 600-volt circuits, 300 volts to ground as required by the NECode.

Since the luminaires were installed on wood arch trusses, a ground wire (third conductor for each branch circuit) was connected to each luminaire and run all the way back to the generator to insure a positive ground.

Use of a combination incandescent-mercury lighting system for lighting of the Field House on a standard 60-cycle power system would have required a distribution system containing 84 circuits ranging in size from No. 12 to No. 8 wire, depending on the length of runs and permissible voltage drops. The more efficient 400-cycle 600-volt system adopted requires far less power to be distributed, and only 14 circuits of No. 12 wire. The maximum load on any branch circuit is less than 7 amps and averages about 5 amps.



LUMINAIRE CROSS-SECTION through three of 14 lamps used per unit. Lamps are 8 ft long, spaced 8-in. on centers, in aluminum reflectors open at top to provide indirect light component. Half of lamps use single-lamp capacitor ballasts, other half single-lamp choke coil ballasts, to provide unity power factor for branch circuit.

A significant fact about this installation is that no particular distribution problems were created by the 400-cycle power, due primarily to the small amounts of current being handled. Test runs on a 400-ft circuit of No. 10 wire both in steel conduit and laying on a wooden floor, over frequencies ranging from 60 to 10,000 cycles, showed line impedance and effective resistance at 400 cycles were approximately the same as at 60 cycles and for all practical purposes could be ignored.

Branch circuit conduits installed on the bottom of the seven 196-ft span wooden arches were put in place while the huge prefabricated spans were still on the ground in three pieces as received from the Oregon supplier. It was then an easy matter to connect these runs to the branch circuit pull boxes later installed along the curved ceiling at a low point.

The entire 400-cycle power system and all 60-cycle equipment used in connection with it except the luminaires, was designed, developed, and furnished by the General Electric Company.

High-frequency circuit design and development work which made the Union College 400-cycle lighting feasible has been done by John H. Campbell, G-E illuminating engineer, Nela Park. Also cooperating on the Union College job was Howard D. Kurt, G-E electrical engineer, who designed the wiring system for the 400-cycle power system and cooperated in the design changes of the frequency converters.

Architects for the new Field House were McKim, Mead and White, and consulting engineers were Harry Bond & Associates, both of New York. The electrical installation was made by M. Gold & Son, electrical contractors of Schenectady, N. Y., under supervision of Ned Miller of that firm.

High Frequency Lighting Progress

Soon after the introduction of the fluorescent lamp in 1938, the General Electric Company established a laboratory in Nela Park to investigate and study fluorescent circuits of all types including high frequency operation of these lamps. Prior to this time it was not known that high frequency operation would provide more desirable characteristics with electric discharge lamps than would 60-cycle operation. Preliminary results showed wattage losses at electrodes are less at higher frequencies, control components such as reactors and capacitors become smaller and lighter in weight, with many other inherent benefits and resulting advantages.

Taking over this research and study from the beginning, John H. Campbell, G-E engineer, has carried on this work at Nela Park up to the present, except for a brief period during World War II, (1942 to 1945). Out of his work has emerged many new circuits for control and operation of fluorescent lamps, including the dimmer control circuits for hot cathode fluorescent lamps which he developed in cooperation with H. E. Schultz of the same laboratory and engineers in the Specialty Transformer and Ballast Department at Fort Wayne, Ind. ("Dimming Hot Cathode Fluorescent Lamps", *EC&M*, February 1953). A major development in the high frequency field was the static frequency converter designed around ballast circuits developed by Campbell and converter circuits by B. D. Bedford of General Engineering laboratory in Schenectady installed in a special lighting application at Beltsville, Md., for the U. S. Dept. of Agriculture, and reported in EC&M, November 1954 in an article titled "Magnetic Frequency Multipliers for High Frequency Operation of Fluorescent Lamps". Modification of the 30-kw rotary-type converters for the Union College high-frequency lighting system was carried out under the supervision of Campbell, in cooperation with H. D. Kurt, G-E industrial power engineer for the General Electric Company in Schenectady, based on results of his research and studies in

this field. Technical data and background information used in this article are based on the various reports made by Mr. Campbell and his coworkers before some of the engineering societies, and as supplied by him direct.

Viewed broadly, a high-frequency fluorescent lighting system consists essentially of a high-frequency power source, a distribution system, and luminaires with ballast control devices, similar in all respects to a standard 60-cycle fluorescent lighting system with minor exceptions. These exceptions, and the inherent characteristics of fluorescent (electric discharge) lamps and control components, provide benefits and advantages which favor the higher efficiencies. For example, in a typical high frequency lighting system the frequency converter may also be considered as a transformer, and as one large "ballast" in a single unit rather than a large number of ballasts distributed among the individual luminaires.

Campbell's research has shown that the efficiency of fluorescent lamps increases as the frequency is increased (see Chart). Of even greater importance, lamps can be loaded to greater wattage at higher frequencies without shortening the life of the lamps. This makes it practical to step up the light output of luminaires, provided proper brightness and shielding are maintained. In the Union College installation, for example, 96T12 slimline lamps which are designed to be operated at 425 ma on 60-cycle ballasts were stepped up to 600 ma lamp current at 400 cycles with a resulting increase of 21% in light output.

While stroboscopic effect is seldom a problem on 60-cycle applications, except in certain manufacturing operations, this effect is practically eliminated at 400 cycles when a lead-lag ballast is employed.

Of particular interest to lighting equipment designers, architects, and others is the fact the fluorescent components such as ballasts, reactors, and capacitors become smaller and lighter as the frequency of the power increases. This permits better luminaire designs, reduces luminaire weight, and power losses which emerge as heat within the luminaire.

Capacitor ballasts are not practical on conventional 60-cycle systems because of the peak wave form delivered to the lamp. But at frequencies of 300 cycles and above a capacitor will deliver essentially a sine wave of current to the lamp when a sine wave of voltage is applied. The resulting reduction in ballast weight when the capacitor is used is 90% as compared with that required for 60 cycles.

Choke-coil ballasts are also smaller and lighter for 400 cycles as compared with those designed for 60 cycles. A 600 ma choke coil for one 96T12 slimline lamp, for example, weighs approximately two pounds for 400-cycle operation, while a 60-cycle equivalent would weigh about eight pounds.

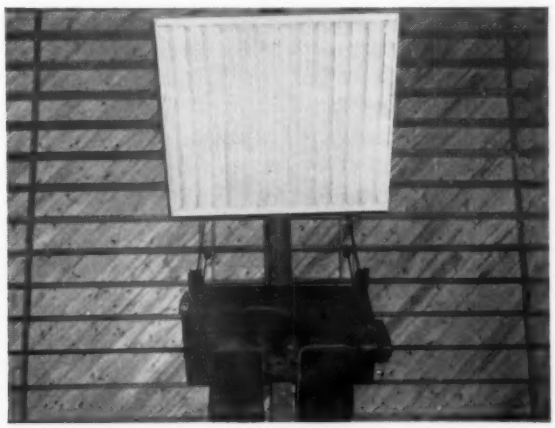
Because of the increased light output per watt, and the lower wattage losses within the luminaires on high-frequency circuits, branch circuit wiring costs can be reduced. This makes for lower initial wiring and installation costs, and lower operating costs.

An indirect benefit which would obtain on a high-intensity lighting installation operating on a high-frequency power system would be the savings accruing in air conditioning systems, due to the reduction in energy consumed by the luminaires, and the resulting heat dissipation.

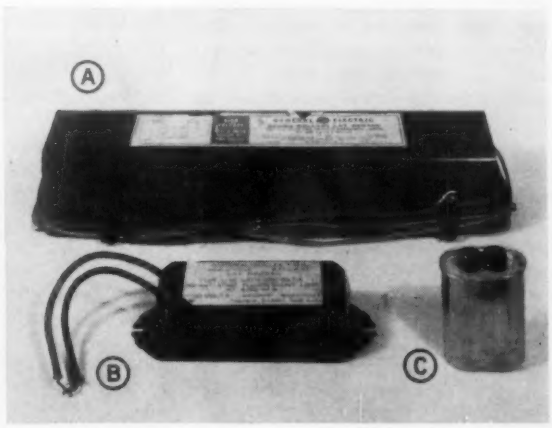
As a result of these circuit developments some of the first installations of high-frequency fluorescent lighting were applied to aircraft, where 400-cycle power has been more or less adopted as a standard. Also, installations were made on transportation buses back in the late 1940's, and today it is estimated some 800 or more buses are so equipped. In both instances higher-than-60-cycle power systems were selected (usually 400 cycles) for weight considerations. Fluorescent lamps were adapted to these high-frequency systems because of the much smaller cost and more efficient ballasts.

In 1951, a special installation of high-frequency fluorescent lighting was made in the Plant Industry Station of the U. S. Department of Agriculture at Beltsville, Md. Special circumstances made this installation practical, plus the fact that B. D. Bedford and Lloyd Harriett of the General Engineering Laboratory in Schenectady at the request of J. H. Campbell developed a practical static frequency converter for fluorescent lighting and General Electric's Specialty Transformer Department was prepared to produce a unit based on this circuit.

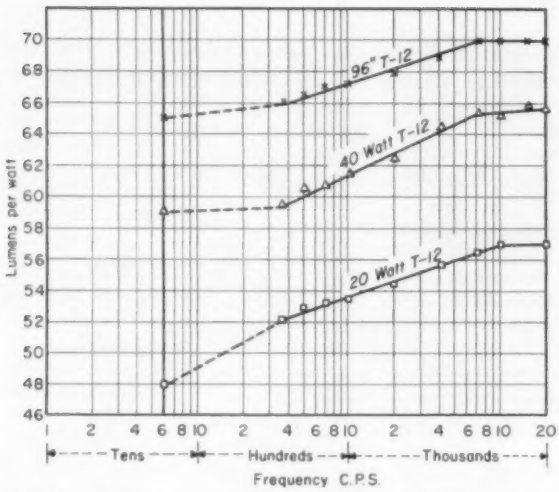
In the Beltsville installation, the problem was to provide a lighting system which would permit lighting in-



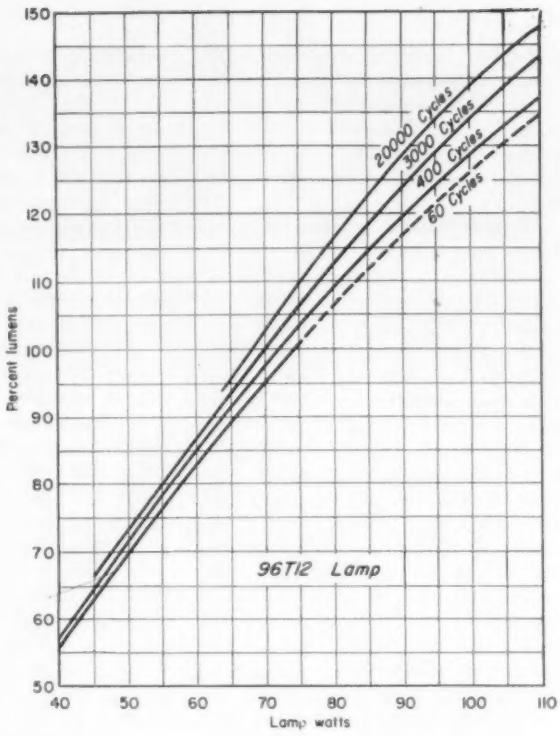
EACH LUMINAIRE contains 14—96T12 fluorescent lamps, is 8-ft 6-in. square, has two-piece hinged diamond mesh wire guard across bottom surface. Support is by welded link steel chain hung from ceiling hooks and connected to eye bolts at each corner of luminaire.



SIZE OF BALLAST is reduced for higher frequency operation. Top unit (A) is 2-lamp ballast for two 96T12 lamps at 425 ma, 285 volts, 60 cycles. Bottom unit (B, left) is single-lamp choke coil for 96T12 lamp operated at 600 ma, 600 volts, 400 cycles. Bottom (C, right) is capacitor ballast.



EFFICIENCY increases for fluorescent lamps as frequency is increased. Data shown represent test results with constant lamp watts and 600 volts on 96T12 lamps, 400 volts on 40-watt T12 lamps, and 120 volts on 20-watt T12 lamps, as reported by J. H. Campbell.



HIGH FREQUENCY operation of fluorescent lamps permits loading to greater wattage without sacrifice of lamp life. For 96T12 lamp, by increasing frequency from 60 cycles to 400 cycles, and lamp current from 425 ma to 600 ma, expected life is maintained and light output is increased 21%.

tensifies of more than 2000 foot candles throughout an underground plant growth laboratory. Before high-frequency fluorescent lighting was made available, the Department of Agriculture had lighted some of these laboratories with fluorescent lamps, using conventional 60-cycle power and standard T8 slimline lamps controlled by 2-lamp 60-cycle ballasts. The intensities required made it necessary to place the 96T8 lamps as close together as possible. Since fluorescent lamps are designed to produce their optimum output at an ambient temperature of about 80 degrees F., it was found that the lamps should not be closer together than about one inch; also that it was desirable to locate the ballasts remotely to eliminate the heat from the watts loss in the ballasts. Furthermore, the weight of the ballasts created a serious problem if they were located "with" the lamps in the conventional manner. Thus the ballasts were remotely located on adjoining corridor walls outside the laboratory rooms, which required installation of a maze of complicated and costly wiring, as shown.

With the availability of a practical frequency converter, a subsequent laboratory was lighted with a 360-cycle high frequency lighting system. A magnetic frequency multiplier (static converter) was used to provide the high frequency power. This converter has no moving parts and can be treated as a transformer. Two 5-kw units were installed at the Beltsville installation. With these, it is possible to provide a square current wave form which allows higher lamp loading and greater lumen output.

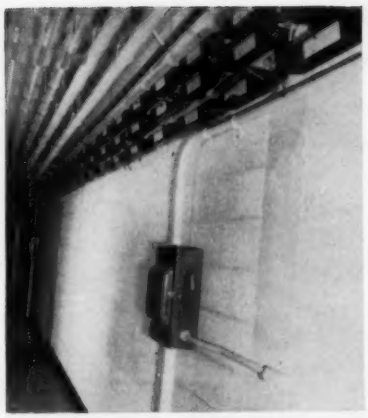
A control on the panel of the magnetic frequency multiplier makes it possible to regulate the current to the lamp load, which permits varying of the lamp's light output. With this arrangement it is possible to maintain a constant lighting intensity in an installation throughout the life of the lamps, compensating for light loss due to dirt accumulation and similar causes. In fact, this feature could be made automatic.

Why 60 Cycles?

Since fluorescent lamps operate more economically at higher frequencies, and transformers use less materials when operated at higher frequencies, etc., the question arises as to why the electric power companies adopted 60 cycles as a standard for frequency in the first place. According to J. H. Campbell, who has done some research on this subject, there are perhaps some logical explanations. But the fact remains that it is highly extravagant and costly in materials and natural resources, as well as in dollars.

From 1886 to 1890, the early producers of electric energy delivered 133-cycle ac power by means of belt driven generators, as well as considerable dc power. At the time engineers did not think ac systems could be expanded by means of belt driven equipment and slower direct driven generators were then used. Then 60-cycle power was selected as a suitable compromise. As slower water power equipment was adopted for driving the generators, 25-cycle power made its appearance. After the turn of the century turbo-generators were introduced and by 1910 60-cycle power was leading all other frequencies, and efforts at standardization were made. Eventually the size of the investment in 60-cycle plant and equipment was so large that any efforts to change frequencies to a more desirable value soon met with defeat particularly since high frequency distribution over long lines at high current is more expensive. The answer to the problem now probably lies in the development of highly efficient low cost converters. Developments now in progress indicate that considerable succes in this direction is possible and probable over the next few years.

CAPACITORS, 3 oz. weight, serve as ballasts on 400-volt fluorescent lighting system in Union College Field House. They are smaller than a package of cigarettes.

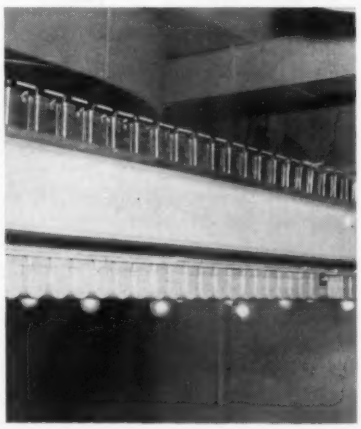


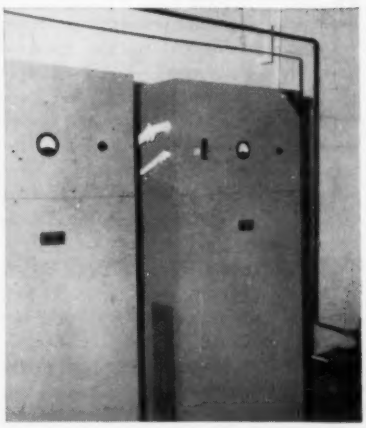
FLUORESCENT SLIMLINE lighting systems for conventional 60-cycle operation were installed in underground laboratories for plant research by U. S. Department of Agriculture, Beltsville, Md. Ballasts were located remotely in corridor outside rooms to aid in temperature and humidity control. Bank of 60-cycle ballasts shown (right) are required to operate lamps in laboratory (left).

The fact that two sizable installations of high frequency lighting have already been made, and on a sound economic basis, is proof that there is a market for this advanced and highly efficient lighting system. For any lighting problem today where relatively high levels of illumination of good comfortable quality are needed, or where high lumen output with a minimum of heat and weight is called for, high frequency lighting in all probability offers the most economical solution.

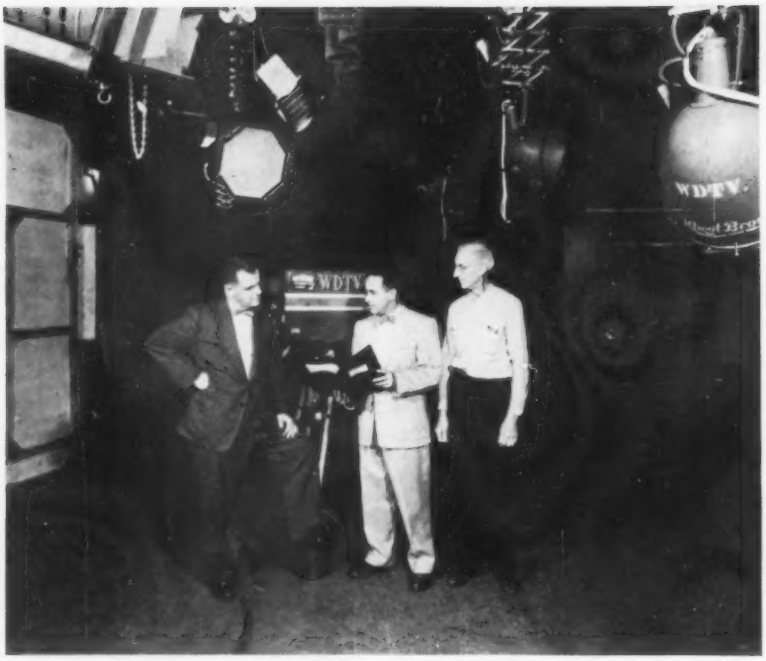
Several high frequency lighting systems are now well beyond the blueprint stage, aside from the aircraft and bus installations and the pioneer installations which have been confined more or less to specialized applications. Aside from two installations now being made by General Electric's Lamp Department, one lighting equipment manufacturer is putting a complete installation of high frequency lighting in an office building. As confidence in its practicability is gained, based on experience gained on existing jobs, and as more is learned of its operating economies and many advantages, its use will spread rapidly in commercial and industrial buildings where quality lighting is needed and appreciated.

FLUORESCENT BALLASTS used on the 400-cycle high-frequency lighting system are examined by Ray Seidel, (left) Curtis Lighting representative who sold the special 14-lamp 8-ft-sq luminaires, and Ned Miller, job superintendent for M. Gold & Son, electrical contractors who installed this pioneer lighting installation.





FIRST HIGH FREQUENCY fluorescent lighting system with magnetic frequency multiplier (converter) installed to convert 60-cycle power to 360 cycles was made at the Beltsville laboratories in 1951. It provides intensities up to 2300 footcandles, requires only 2-oz. capacitor ballasts (center). Two 4.5 kw magnetic frequency multipliers (right) supply the 360-cycle power.



ILLUMINATION for live televising is provided by shuttered spots, scoop floods, series border lights and variety of special luminaires chain-suspended from pipe battens, pantograph-supported or counterbalanced on Reelite units from the high-bay studio ceiling. Power is provided through plug-in strips, pin-plugged extension cables or circuits controlled directly from dimmer board or various directors' stations. Pictured discussing this circuiting are (left to right) chief engineer Ray Rodgers, Hale Electric supervisor Don Jones and installation foreman Ernest Barthel.

Power and Light for Television

High orders of electrical engineering and installational craftsmanship have provided television station KDKA-TV with unusual wiring flexibility and reserve power capacity sufficient to triple existing lighting and air conditioning for possible future color telecasts.

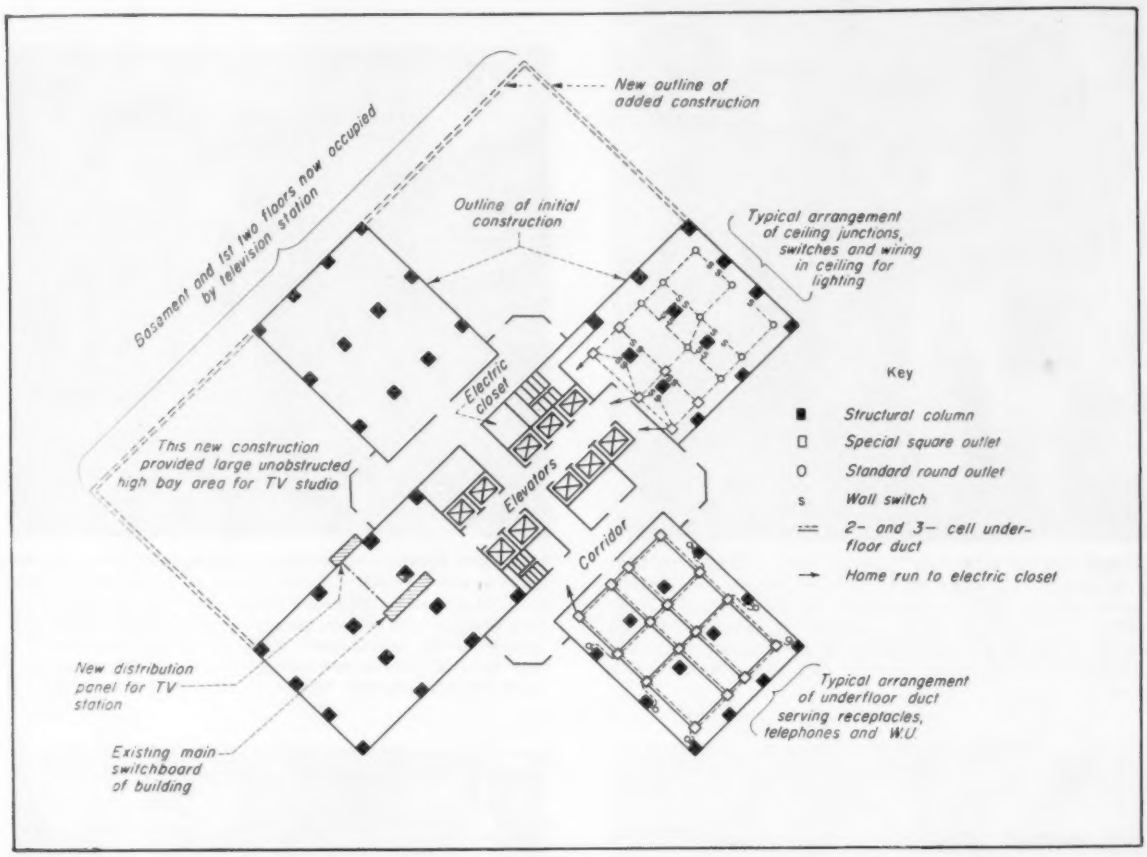
By Donald S. Jones
Hale Electric Company
Pittsburgh, Pa.

GATEWAY Center — impressive metal-sheathed commercial development situated at the apex of downtown Pittsburgh—is an example of top-drawer engineering and construction. Completed several years back (see EC&M, May 1952), it received prompt recognition as an ideal office site, for it combined the highest standards of service, comfort, convenience, air conditioning and beauty. Designed in the form of huge 200-ft crosses with arms measuring 50 feet through, each of the several buildings contains elevators, motor rooms, electric service closets and utility shafts within its central core. Then, from these cores, 120/208-volt branch circuits extend outwards into the wings, carried in floor slabs and stubbed down to provide light for the floors below; and stubbed up to serve underfloor ducts, receptacles and telephones on the floors above.

This design amply fulfilled all requirements of the average tenant, but one tenant was far from average. That tenant was Dumont television station WDTV (which became Westinghouse station KDKA-TV as this article was being prepared). This studio's requirements called for a large floor area unobstructed by intermediate structural columns and having a 2-story ceiling height. The station's lighting and air conditioning requirements also were above average and—if and when the studio makes the jump from black-and-white to color telecasts—these already-above-average requirements will be more than tripled.

To supply these added requirements construction-wise, two 2-story additions were erected, one on either side of one of the building's wings. One of the additions was left entirely unobstructed to provide the required large high-ceilinged studio, while the other addition was erected along conventional column-and-floorslab principles to provide additional office space.

Electric-wise, the problem was solved by locating a new distribution panel in the basement beneath the large studio addition, extending feeders directly to this panel from the

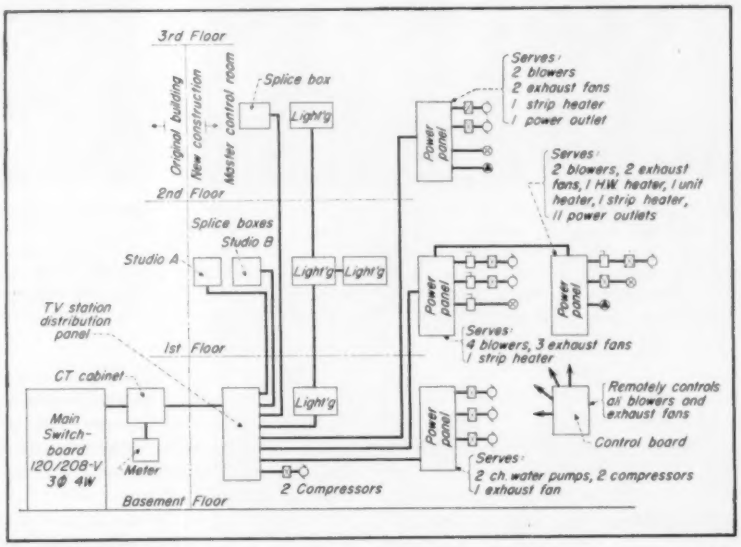

New outline of added construction
Basement and 1st two floors now occupied by television station
Outline of initial construction
Typical arrangement of ceiling junctions, switches and wiring in ceiling for lighting
Electric closet
This new construction provided large unobstructed high bay area for TV studio
Elevators
Corridor
Key
Structural column
Special square outlet
Standard round outlet
Wall switch
2- and 3- cell underfloor duct
Home run to electric closet
New distribution panel for TV station
Existing main switchboard of building
Typical arrangement of underfloor duct serving receptacles, telephones and W.U.

LARGE TELEVISION STUDIO was created by erecting 2-story open-bay addition between two wings of original Gateway Center building, while added office space was obtained by second addition constructed conventionally. Greatly increased electrical demand necessitated extension of feeders from main switchboard to new distribution panel, thence to load centers for air conditioning, power and lighting. Wing of original building is additionally served by underfloor duct and lighting systems wired from service closet in building's central core.

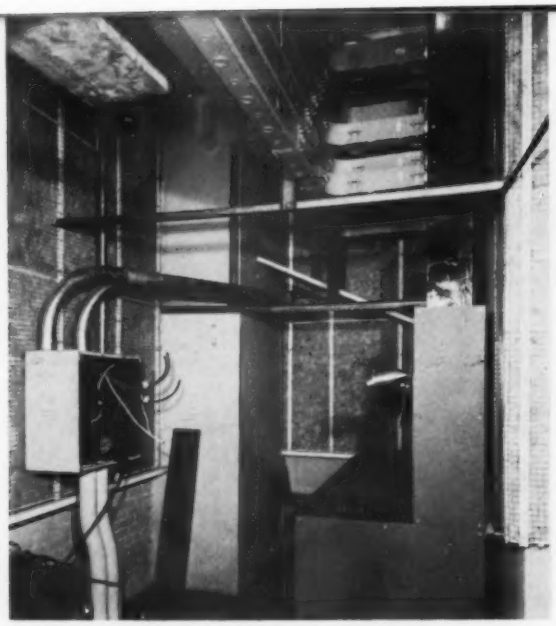
building's main switchboard, then locating the necessary auxiliary air conditioning equipment partly in the basement and partly on the second floor of the second addition.

This solution resulted from a huddle between architect Irwin Clavan and consulting engineers Meyer, Strong and Jones of New York City. Actual electrical installation was by Hale Electric of Pittsburgh, with Hale's supervisor Don Jones and foreman Ernest Barthel cooperating closely with Dumont engineers and Station Engineer Ray Rodgers in the development of many installation details as the job progressed.

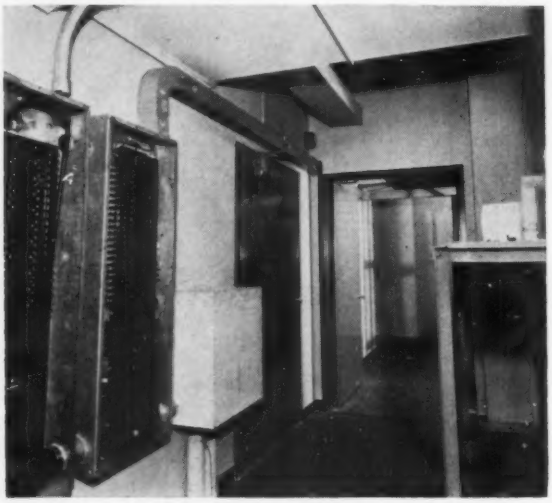
In this $1½-million installation, one of the electrical features is the provision for major expansion of service, for present lighting and air conditioning loads will be boosted tremendously if and when the station originates live programs in color. For that reason all feeders, panels and breakers have capacities for far greater loads than are now carried.



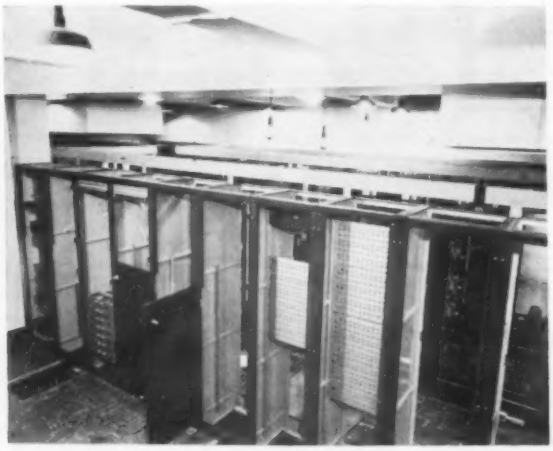
DISTRIBUTION to splice boxes, control room, power and lighting panels is via cables in conduit, while flexibility of wiring dictated use of considerable trench, floor duct and square wireway sections between those central points and local or portable apparatus. Equipment such as blowers or exhaust fans may be switched either locally, from their related power panels, or from a remote control board. New wiring in studio exceeded 26 miles in total length.



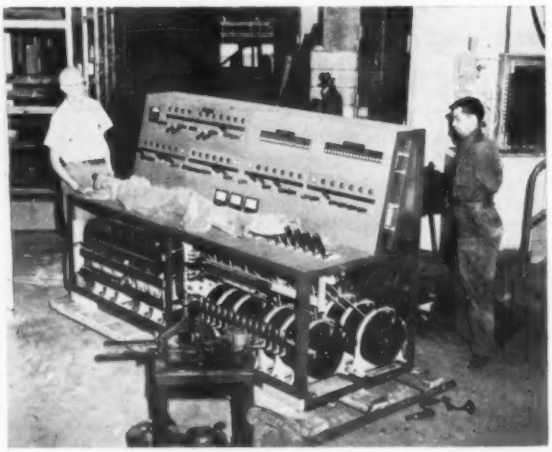
LARGE SPLICE BOX (left) provides main studio with 500-amp capacity via eight 300MCM cables rising directly from feeder breaker on basement-based distribution panel. Flexibility of wiring for various programs is obtained through use of plug-board (right), banks of continuously accessible wireways (above), floor trenches and standard underfloor duct.



LIGHTING PANEL with provision for 84 branch circuit breakers is in two sections with main breaker at bottom of each. Wide panel gutters, solderless connectors, color coding, circuit identification and phase balancing are standard practices throughout the installation. Surface-mounted wireways and floor trenches provide continuous accessibility to branch wiring to facilitate routing, tapping or rearrangement of circuits.



EQUIPMENT RACKS in rooms flanking master control room straddle floor trenches, thereby providing for easy addition, recircuiting, splicing or inspection of wiring. Trenches extend through partitions to control points, risers and main splice boxes. Ventilation louvers in panels are backed by Fiberglas filters to exclude dust particles from tiny contacts within.

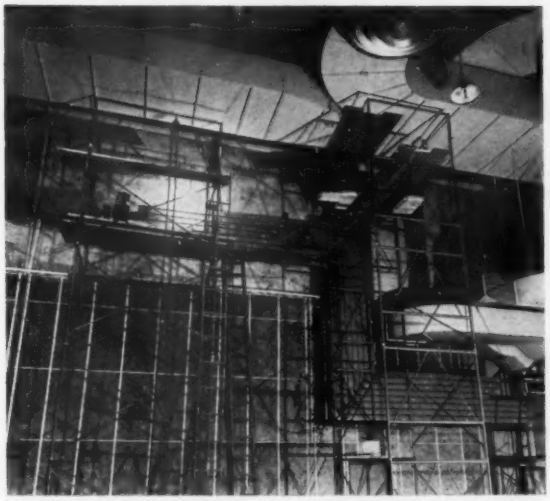


DIMMER BOARD for controlling lighting of main studio is equipped with 24 5-kw interlocking circular-type dimmers plus nine additional circuits which can be operated conjunctionally in accordance with pre-set combinations. All switches, plugging receptacles and fuses are included in this packaged self-contained unit.

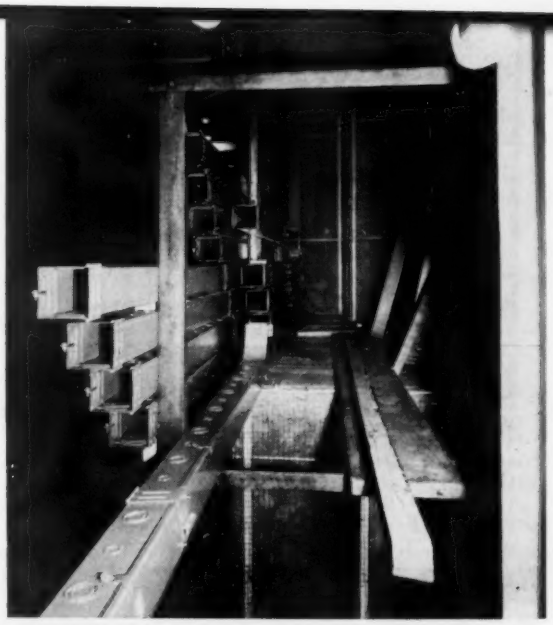
Another feature of the distribution system is its provision for easily extending, rerouting or increasing present wiring, for constant advances in television progress and frequent rearrangements of studio set-ups and lighting make this flexibility a definite requisite. For that reason considerable circuiting is through underfloor ducts, floor trenches and banks of square wireways. Plug-in strips are also used in several locations. Collectively, these readily accessible wiring mediums run around, over and beneath both studios; connect risers, splice points, control rooms and equipment racks.

A third feature of the system pertains to noise suppression and, towards this end, all motor and compressor rooms are paneled with Fiberglas. Equipment subject to vibration is mounted on rubber shock absorbers, while transmission of vibration through the structural framework of the building is further suppressed through the use of flexible electrical connections between motors and rigid raceways. Even air-conditioning ducts were designed with sound-dampening in view and, as a result, they are liberally dimensioned so that sufficient volumes of air may be handled without involving high air speeds or turbulence.

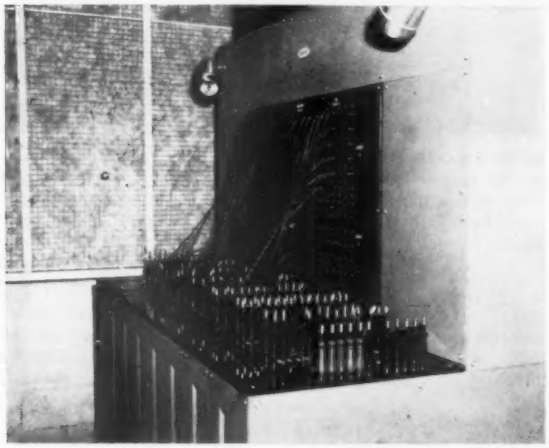
Of nine new feeders radiating from



ELECTRICAL FLEXIBILITY within main studio is augmented through use of 1600 feet of square wireway which encircles and spans the 500-sq ft floor area. Wiring is accessible at all locations, thereby promoting possibilities for fast expansion, rearrangement of circuits or positioning of special equipment in any desired location. Installation was accomplished with aid of sectional scaffolds and large variety of power tools.



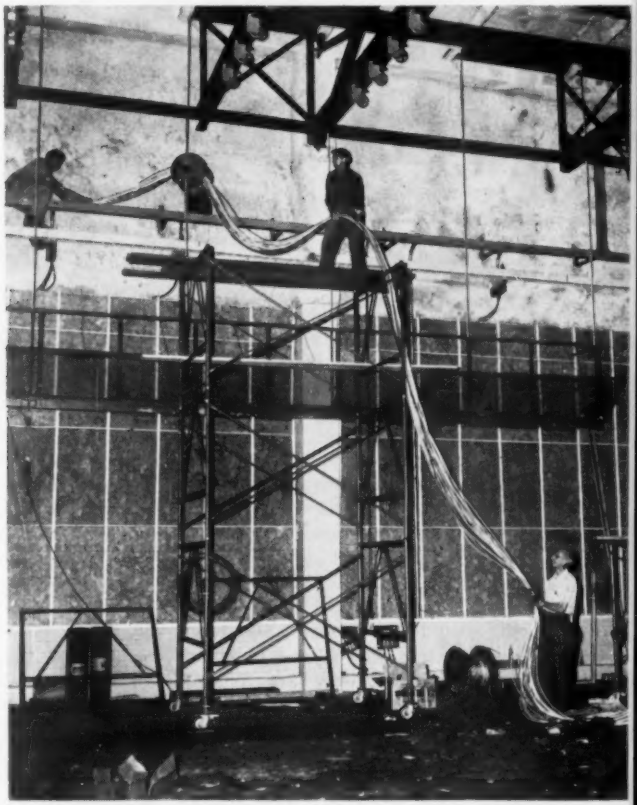
SQUARE METAL DUCTS along studio walls promote both adaptability and accessibility of wiring for power, lighting, signaling and communications. Ducts, installed in concentrated banks, are supported by bolts through vertical angle iron members. Use of ducts merited high endorsements by contractor, engineer and maintenance staff at this television station.



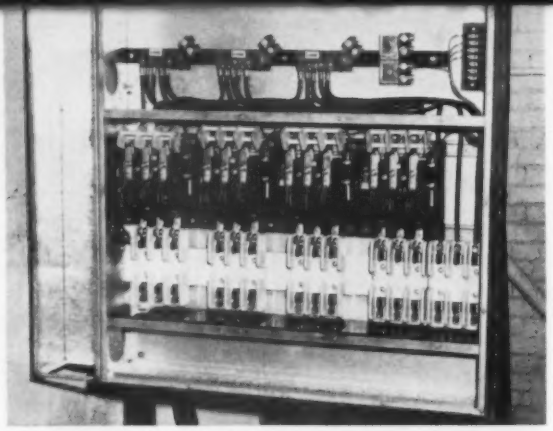
PATCH PANEL plug-board makes it possible to connect any of 220 different circuits to the adjacently-located dimmer board. This unit, plus much of the other electrical equipment in the new television station, was designed specially for this installation. Possible load expansion for anticipated color telecasting was provided for in the design and service.

the new distribution center, the majority of breakers are rated between 500 and 300 amps with feeders terminating in studio splice boxes, master control room, power or lighting panels. Power is used mainly for compressors, pumps, blowers and exhaust fans, strip and unit heaters, plus numerous duplex power outlets in such locations as carpentry and engineering shops. All blowers and exhaust fans, which are part of the interior air handling system, are remotely controlled from a basement panel as well as from related distribution panels or local motor starters.

Throughout the installation are numerous installations of 3- and 4-way lighting switches to promote con-

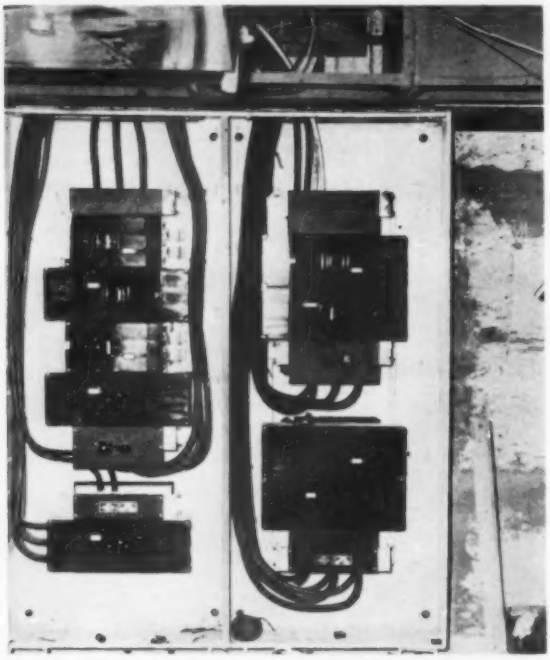


INSTALLATION of wiring into the 4-by-4 metal ducts mounted on upper walls of the studios was facilitated through the use of rolling sectional scaffolds. In the main studio alone, 80,000 ft of wire was so installed in 15 ducts totalling 1600 ft in length. Sheaves mounted beneath roof trusses are for stage rigging.



CONTACTOR PANEL related to dimmer board in main studio distributes lighting load between phases of the 4-wire 120/208-volt system. Ample wiring space is provided above and beneath horizontal ebony-asbestos partitions.

SOUND PROOFING of compressor and motor rooms is by means of 2-in. Fiberglas panels mounted with an inch of air space between them and the enclosing concrete walls. Control panels are supported on shock-dampening brackets.



DISTRIBUTION PANEL beneath main studio obtains power directly from main switchboard of the building through six 500-, six 400- and 16 300MCM cables. The nine feeder breakers have trip ratings to 500 amps.

UNDERFLOOR DUCT in new office space is used for telephone and video picture distribution only. Power feeding duplex receptacles is distributed through slab-contained conduit. Floor outlets are on standard 2-ft intervals and marker inserts located ducts at all terminal points and partition lines.

venience and safety, although all switches in public spaces such as halls or stairways are key-operated to prevent unauthorized tampering. Branch wiring for power and lighting is generally Type RH, No. 12s or larger being used consistently, and No. 10s being used as the minimum size when branch circuits exceed 100 ft in length.

Local control panels have common neutral buses, breakers only on outer phase legs of circuits, feeder lugs secured to phase buses by stud bolts, wide gutters for wiring facility, color coding and circuit identification labels.

Lighting in offices, shops, reception and public areas is mostly conventional, with recessed, surface-mounted or suspended fluorescent luminaires equipped with diffusing glass or egg-crate-louvered bottom panels. Recessed incandescent units are also used in locations such as over the main information desk, with lamps generally housed in prismatic glass reflectors, and with round Controlenses in metal frames.

Lighting equipment in studios includes deep parabolically curved spun-aluminum floodlight reflectors of the scoop type with mogul sockets for base-up lamp positioning; spotlights with concentrated filament projection lamps—variously equipped with Fresnel lenses, reflectors on sliding carriages for focusing, or shutters for framing; border lights with individual semi-matte reflectors suspended from pipe battens for general illumination, plus a wide variety of special floods, spots, strips, scenery and effects projectors. Lighting equipment is powered from batten plug-in strips, wall receptacles or extension cords frequently linked together by locked pin-plug connectors that provide simple, direct and positive means for establishing temporary connections.

This television station is outsized by several studios located on our two coasts, yet its many features for wiring flexibility, control and expansion; its variety of circuiting mediums that at present carry 26 miles of wiring; its well-engineered electrical distribution system; and it's many evidences of installational craftmanship make it one of the finest of Pittsburgh's showplaces.

THREE-YEAR PLANS FOR

New Plants and Equipment

1. ***U. S. business as a whole plans to spend more for new plants and equipment in 1955 than in any previous year.*** **Manufacturing companies plan to increase capital spending 3% this year. All business together plans an increase of 5% over the total for 1954.**

2. ***The rising trend of capital spending may carry far beyond 1955, judging by industry's present plans.*** **Preliminary plans for 1956 are only about 3% lower than plans for 1955. In the past, plans for future years have always been sharply lower than those for the current year. If preliminary plans are revised upward—as they have always been in the past—1956, 1957 and 1958 will be years of high, and perhaps record, capital expenditures by business.**

3. **Manufacturers devoted 27% of their capital expenditures in 1954 to new construction and 73% to the purchase of new equipment. The division will be about the same in 1955, according to present plans—28% for construction and 72% for equipment. This is the first available information on current and future years, based on a large sample, on the distribution of manufacturers' capital spending between construction and equipment.**

These are some of the highlights of business' plans and expectations, based on replies to the eighth annual McGraw-Hill Survey of Business' Plans for New Plants and Equipment.

UNITED STATES business plans to spend $29.4 billion for new plants and equipment in 1955, about 5% more than the amount spent in 1954 (Table I). The largest increase among major industries, 15%, is planned by commercial companies—those in the trade, finance, construction and service industries. Gas utilities and manufacturing companies also plan to spend more than they did last year. Electric utilities, railroads and mining companies plan small reductions in their capital spending, while other transportation and communications companies and the petroleum industry plan to invest about as much as in 1954. (Table II).

These findings confirm the key result of the regular survey by the Securities and Exchange Commission and the U. S. Department of Commerce. The SEC-Commerce survey also indicated that business plans to increase its capital spending in 1955, although by a smaller percentage.

Manufacturing industries plan to spend $9.2 billion for new plants and

Table I — BUSINESS' PLANS FOR CAPITAL SPENDING

Millions of Dollars

	1954 Actual*	1955 Planned	1954-1955 Percent Change	Preliminary Plans 1956	1957	1958
All Manufacturing	$ 8,915	$ 9,226	+3%	$ 8,561	$ 8,237	$ 8,037
Petroleum Industry[1]	4,900	4,913	0	4,961	4,921	4,920
Mining	396	387	−2	298	237	251
Railroads	854	820	−4	812	795	754
Other Transportation & Communications	2,975	2,969	0	3,082	3,026	2,743
Electric & Gas Utilities[2]	4,219	4,430	+5	3,766	3,544	3,987
Commercial	6,379	7,336	+15	7,556	7,629	6,969
ALL BUSINESS	$27,888	$29,391	+5%	$28,380	$27,802	$27,143

*Department of Commerce, Securities and Exchange Commission, McGraw-Hill Department of Economics

[1]Petroleum refining, included under both manufacturing and petroleum industry, is counted only once in the total

[2]Electrical World, American Gas Association, for 1955-58

equipment this year, about 3% more than in 1954 (Table III). Among major manufacturing industries, the largest increase in capital spending, 28%, is expected in the primary metals industries—non-ferrous metals and iron and steel. Chemical processing companies plan to spend 7% more for new plants and equipment than they did last year. Textile companies plan an increase of 5%, while industries in the miscellaneous manufacturing category expect to increase capital spending by 3%. Miscellaneous manufacturing includes apparel, lumber, furniture and other industries not covered by the other major manufacturing categories.

Very few major manufacturing industries expect a lower level of capital spending this year. Metalworking companies (including those in the machinery, electrical machinery, auto, other transportation equipment and other metalworking industries) plan a reduction of 3%, while companies in the food and beverages industries plan to cut capital spending by 7%.

Practically every manufacturing industry has increased its plans for capital spending since last fall. At that time, a survey of preliminary plans for 1955 indicated that capital spending by manufacturing industries would be about 7% lower this year than in 1954. All but three of the manufacturing industries have increased their plans since that time. Only one, the group of industries included under "miscellaneous manufacturing", reduced its plans—from an increase of 5% to an increase of 3%.

Business reports preliminary plans for a very high level of capital expenditures in the years immediately after 1955. Plans for 1956 are just 3% lower than for 1955 for all business, and 7% lower for manufacturing companies. Preliminary plans for 1957 and 1958 are slightly lower than those for 1956.

These preliminary plans support extremely optimistic expectations for business capital spending in the next few years—more so than those reported in any previous McGraw-Hill survey. Experience with previous surveys shows that preliminary plans for years ahead are always sharply lower than plans for current periods, perhaps because some companies don't plan fully beyond the current year, and because many companies cannot foresee the contingencies that cause them to raise their investment plans as the years pass. *The fact that preliminary plans for 1956-58 are only*

Table II

NON-MANUFACTURING INDUSTRIES' CAPITAL SPENDING PLANS

Millions of Dollars

	1954 Actual*	1955 Planned	1954-1955 Percent Change	Preliminary Plans 1956	1957	1958
Petroleum Industry	$4,900	$4,913	0	$4,961	$4,921	$4,920
Production	3,300	3,366	+2	3,501	3,568	3,703
Transportation	425	430	+1	387	327	271
Refining & Chemical	750	690	−8	656	587	518
Marketing	350	368	+5	357	372	379
Other	75	59	−21	60	67	49
Mining	396	387	−2	298	237	251
Coal	184	167	−9	182	119	114
Iron Ore[1]	50	69	+38	59	63	67
Nonferrous[2]	122	101	−17	19	19	34
Nonmetallic[3]	40	50	+25	38	36	36
Railroads	854	820	−4	812	795	754
Other Transportation & Communications	2,975	2,969	0	3,082	3,026	2,743
Electric & Gas Utilities[4]	4,219	4,430	+5	3,766	3,544	3,987
Commercial	6,379	7,336	+15	7,556	7,629	6,969

*Department of Commerce, Securities and Exchange Commission, McGraw-Hill Department of Economics

[1] Excludes taconite

[2] Other than uranium

[3] Excludes mining by manufacturing companies

[4] Electrical World, American Gas Association, for 1955-58

Table IV — MORE EMPHASIS ON EXPANSION

Percent of Capital Spending for:

	1954 Actual		1955 Planned	
	Expansion	Replacement & Modernization	Expansion	Replacement & Modernization
Primary Metals	42%	58%	46%	54%
Iron & Steel	39	61	44	56
Nonferrous	54	46	53	47
Metalworking	41	59	41	59
Machinery	33	67	37	63
Electrical Machinery	51	49	52	48
Autos	42	58	38	62
Transportation Equipment (including aircraft)	32	68	48	52
Other Metalworking	45	55	41	59
Chemical Processing	54	46	60	40
Chemicals	69	31	77	23
Paper	53	47	57	43
Rubber	43	57	41	59
Stone, Clay & Glass	45	55	62	38
Petroleum Refining	39	61	33	67
Food and Beverages	42	58	33	67
Food	31	69	26	74
Beverages	67	33	69	31
Textiles	5	95	23	77
Miscellaneous Manufacturing	35	65	46	54
ALL MANUFACTURING	43	57	47	53

Table III

MANUFACTURING COMPANIES' CAPITAL SPENDING PLANS

Millions of Dollars

	1954	1955	1954-1955 Percent	Preliminary Plans		
	Actual*	Planned	Change	1956	1957	1958
Primary Metals	$ 811	$1,042	+28%	$1,142	$ 899	$ 937
Iron and Steel	628	810	+29	850	737	802
Nonferrous	183	232	+27	292	162	135
Metalworking	3,249	3,145	−3	2,727	2,579	2,497
Machinery	694	792	+14	690	673	642
Electrical Machinery	439	483	+10	415	401	367
Autos	1,295	984	−24	915	836	817
Transportation Equipment (including aircraft)	191	199	+4	109	92	94
Other Metalworking	630	687	+9	598	577	577
Chemical Processing	2,827	3,017	+7	2,821	2,825	2,775
Chemicals	1,130	1,243	+10	1,218	1,330	1,318
Paper	455	501	+10	381	366	371
Rubber	131	122	−7	118	124	121
Stone, Clay & Glass	361	461	+28	448	418	447
Petroleum Refining	750	690	−8	656	587	518
Food & Beverages	765	712	−7	606	672	631
Food	534	585	+10	500	506	497
Beverages	231	127	−45	106	166	134
Textiles	331	349	+5	303	320	320
Miscellaneous Manufacturing	932	961	+3	962	942	877
ALL MANUFACTURING	8,915	9,226	+3	8,561	8,237	8,037

*Department of Commerce, Securities and Exchange Commission, McGraw-Hill Department of Economics

Table V — CONSTRUCTION & EQUIPMENT[1]

	1954 Actual		1955 Planned	
	Construction	Equipment	Construction	Equipment
Primary Metals	17%	83%	21%	79%
Iron & Steel	17	83	21	79
Nonferrous	17	83	19	81
Metalworking	25	75	27	73
Machinery	20	80	28	72
Electrical Machinery	30	70	27	73
Autos	25	75	29	71
Transportation Equipment (including aircraft)	24	76	32	68
Other Metalworking	26	74	22	78
Chemical Processing	33	67	31	69
Chemicals	22	78	27	73
Paper	25	75	19	81
Rubber	14	86	14	86
Stone, Clay & Glass	29	71	26	74
Petroleum Refining	58	42	55	45
Food & Beverages	33	67	37	63
Food	38	62	39	61
Beverages	22	78	25	75
Textiles	12	88	12	88
Miscellaneous Manufacturing	23	77	31	69
ALL MANUFACTURING	27	73	28	72

[1]Percent of total capital expenditures

slightly below plans for the current year is thus an indication that actual spending in those years may be considerably higher.

The decline in capital spending plans between 1955 and 1956—3% for all business—is less than one-half the size of the smallest decline ever reported beyond the current year in any previous McGraw-Hill survey. The decline in plans of manufacturing industries is also the smallest ever reported. And the same is true of preliminary plans for 1957 and 1958.

Plans for years after 1955 ***are, of course, highly tentative.*** Even the plans for 1955 could be altered considerably if the business situation seemed to warrant it. But, considered in the context of past planning patterns in the field of capital spending, the preliminary plans for future years are extremely bright auguries for the future.

Plans for Greater Capacity

Manufacturing industry plans to increase its productive capacity by 5% *in* 1955 *and by another* 11% *by the end of* 1958. This rate of increase is somewhat smaller than the one recorded during the recent period of defense expansion; manufacturing capacity increased by 7% in 1951, 9% in 1952 and 7% in 1953. Capacity increased by 5% in 1954.

Chemical, paper and electrical machinery manufacturers plan the largest additions to capacity in the 1955-58 period, reflecting the particularly large gains they expect in their sales. Transportation equipment (other than auto) companies plan the largest increases in 1955 alone—8%—while chemical, paper and electrical machinery companies plan to increase capacity by 7% this year. The smallest increases in capacity in 1955 are planned by petroleum refiners and the iron and steel industry.

More Money for Expansion

Manufacturers plan to devote more of their capital spending to expansion, and less to replacement and modernization this year (Table IV). This reverses a trend that has been maintained for several years.

In 1952 and 1953, at the peak of the defense expansion, manufacturers used almost half their capital expenditures to expand capacity—49% and 48%, respectively. By 1954, the share going to expansion was down to 43%, and manufacturers reported plans for a further sharp shift toward replacement and modernization in preliminary thinking about 1955-1957.

(*Continued on page* 156)

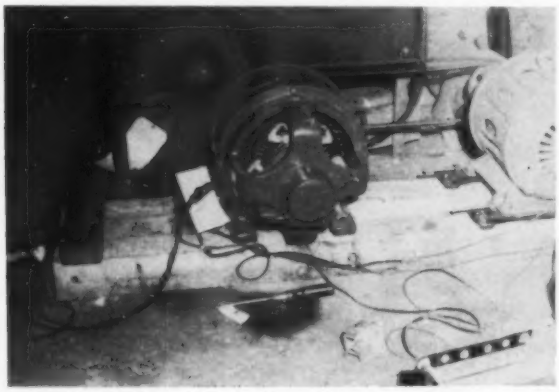
AT THE TEST BENCH—12

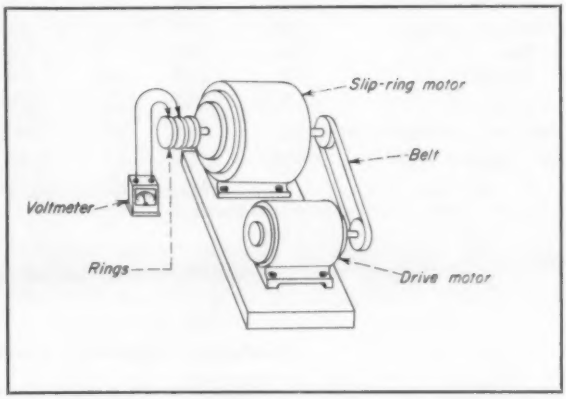
Making a Frequency Doubler

By Walter J. Prise, *Chief Engineer*
Queens Electric Motors, Inc., Jamaica, N. Y.

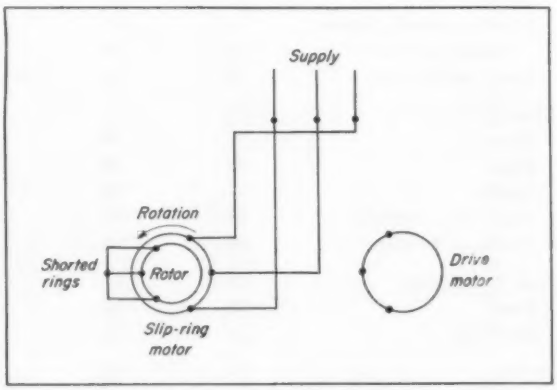
FREQUENTLY, in electric repair and testing practice, the need arises for a source of ac voltage at a frequency higher than 60 cycles. This is also a common need in some industries to operate motors at higher speeds. The woodworking industry often uses voltages at frequencies higher than 60 cycles to supply motors which power smooth-finishing operations and other operations in which high rotating speed is an advantage.

Although a wide range of different frequencies higher than 60 cycles can be obtained from various types of alternators and frequency changers, a simple arrangement of two motors is commonly used to obtain voltage at a frequency of 120 cycles. Such frequency doubling is accomplished by using a slip-ring induction motor as a frequency doubling generator. The main requirement of the arrangement is that the secondary (or rotor) voltage of the 60-cycle induction motor be equal to one-half of the required 120-cycle voltage. For instance, if 230 volts at 120 cycles is required, the secondary voltage of the induction motor to be used must be one-half of that, or 115 volts. The hookup can be made and tested as shown in the following steps:

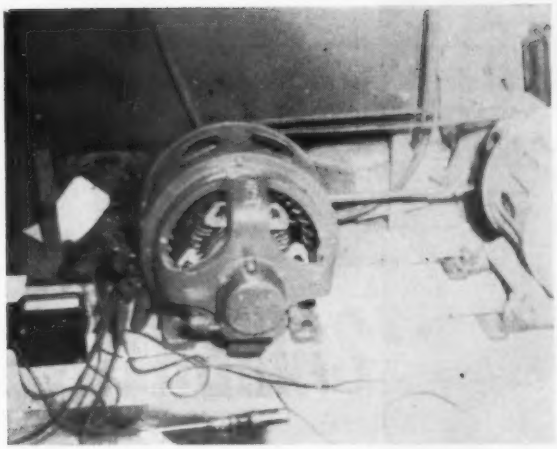


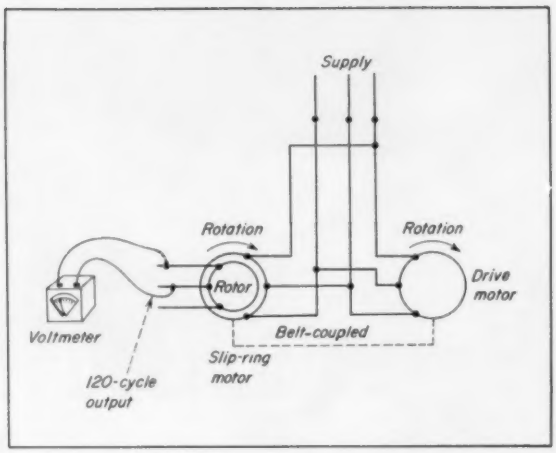


STEP 1. Checking voltage of secondary of the slip-ring motor. Open the secondary of the slip-ring motor either externally or by breaking contact between the brushes and slip rings, either by inserting paper under the brushes or lifting them off the rings. Then with the secondary open, energize the stator of the slip-ring motor and measure the voltage between rings. Inasmuch as the secondary is open, it will not rotate during this check. However, to get an idea of open-rotor voltage during operation, the drive motor can be energized to cause rotation of the slip-ring rotor and the voltage between rings measured again. The measured voltage should be half of the required 120-cycle voltage.

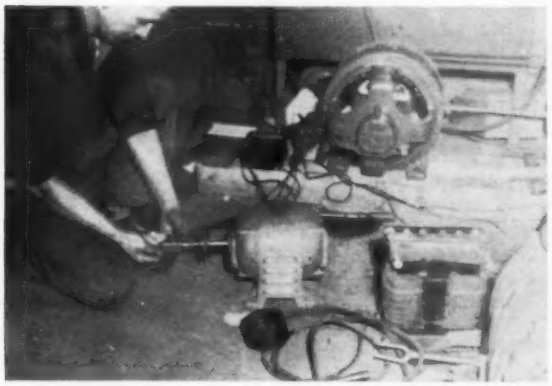


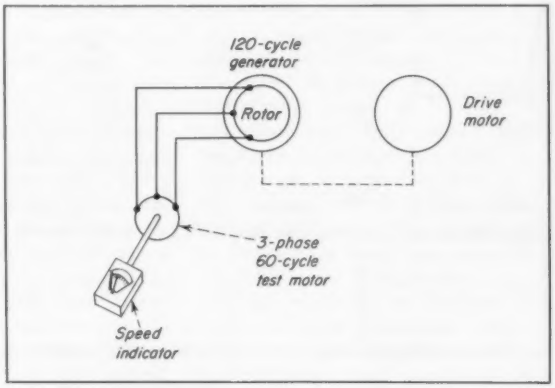
STEP 2. Determining the direction of rotation of slip-ring rotor when the unit operates as a motor. First, disconnect the drive belt from the slip-ring motor. Then, short-circuit the slip-rings and energize the stator of the slip-ring motor. Observe the direction of rotation of the rotor for the particular phasing of supply conductors. This is the direction of rotation for motor operation. The opposite direction of rotation must be accomplished for the motor to operate as a 120-cycle generator. The drive motor is not used in making this rotation test.



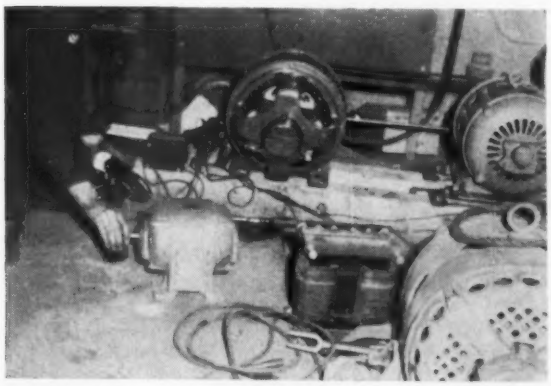


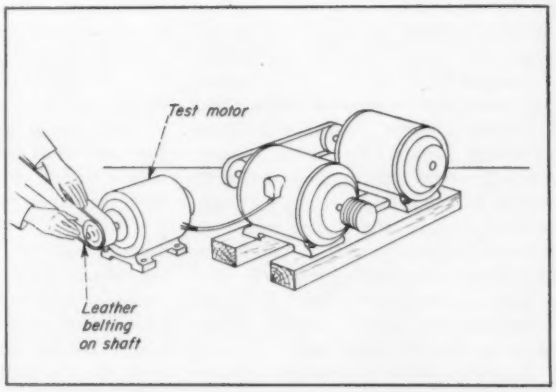
STEP 3. Driving the slip-ring motor so that its rotor is made to rotate in the opposite direction to its rotation as a motor. Check the direction of rotation of the drive motor and determine if it is opposite to rotation of the slip-ring motor operating as a motor. The drive motor must rotate the slip-ring rotor opposite to its rotation as a motor. Direction of rotation of the drive motor can be reversed by reversing two of the supply connections to the drive motor. When proper rotation of the drive motor has been determined, belt-couple the drive motor to the slip-ring motor to drive it as an induction generator. Finally, with the arrangement in operation, measure the 120-cycle voltage between slip rings. This voltage should be double the voltage measured on the open secondary in Step 1.





STEP 4. Measuring the frequency of the generator output voltage. A regular frequency meter can be easily used for this test. However, there is another method for checking the frequency. This method consists of connecting a standard 60-cycle motor of known speed to the generator and checking the speed of this motor with a speed indicator. This motor should run at double speed, proving that the frequency of the generator output is twice 60 cycles.





STEP 5. Determining variations in frequency and voltage of the 120-cycle generator, with variations in load on the unit. This data can be obtained by simply using a leather belting to load the 60-cycle motor which was connected to the 120-cycle generator in Step 4. Measurements of voltage, current and speed will indicate such factors as the capacity of the 120-cycle generator and the capacity of the 60-cycle motor to handle loads when operating at 120 cycles. Careful and thorough testing of the generator should be made and all data recorded to assure proper application of the unit.

QUALITY ILLUMINATION at a 65-maintained-footcandle intensity prevails throughout this banking-office interior in which the plastic shielded luminaires are an integral part of decorative design.

LIGHTING

AN ABUNDANCE of comfortable footcandles today creates an engineered visual environment in the expansive main interior of Metropolitan Savings & Loan Association, Dallas, Texas. Here, both direct and cove lighting techniques are combined as integral elements in the overall modern design of this banking and office interior. The complete lighting installation was made as a result of the sales efforts of E. Jerry Whitlow, vice-president of McClure Electric Company, electrical contractors, Dallas, Texas. Engineering assistance with the lighting layout was given by Dallas Power & Light Co.

Visual tasks pursued in the area are varied. Both continuous, close reading and writing and other casual seeing tasks are part of the normal activity of the business. To provide proper lighting for these tasks, primary design objectives included: high footcandle intensity; freedom from direct glare and excessive brightness ratios; and minimum shadows. And in addition to providing light for critical seeing tasks, the new lighting system had to create a comfortable relaxed atmosphere and have appearance suited to interior design. To realize the design objectives, completely shielded, low brightness equipment was indicated because of the varied viewing angles of the personnel in the area.

As shown in the photos and lighting layout, square fluorescent luminaires with plastic diffusers are used both in the high middle part of the area and in the lower ceiling around the high central area. Special cove lighting is mounted around the edge of the high central area. In addition, niches and wall murals around the interior are highlighted by concealed fluorescent strip units. At the front entrance of the interior, decorative incandescent downlights are suspended above large-leaf green plants which are potted in the low wood partitions and convey a sense of warmth and comfort to customers as they enter the area.

Selection of the plastic-shielded, square units was made on the basis of many factors. Due to the construction limitations and requirements of the building, it was necessary to use luminaires of different size, both recessed and surface, that not only matched but complemented each other. For this reason, 48-in. square surface-mounted units were used in the higher ceiling area where it was impossible to recess; and 24-in. square recessed units were used in the lower ceiling areas along the sides. A modular type of recessed luminaire was selected to fit into ceiling area equal to exactly four acoustical ceiling tiles and also to match the air conditioning outlets in size, shape and finish.

Ten of the 48-in. square surface units are used in the high ceiling with six 48-in. T-12 rapid-start standard cool white fluorescent lamps in each. These units have white plastic shields which are molded with a sweeping arch, slightly higher in the center than at the edges to give extra rigidity. The plastic has a non-specular matte finish providing high light transmission, diffused light spread, low surface brightness, 100% shielding of lamps and ease of maintenance. Forty of the 24-in. square recessed units are used in the lower ceiling around the sides. These units are also plastic-shielded and have the same general characteristics as the larger units, with six 24-in. T-12 trigger-start standard cool white fluorescent lamps in each.

Cove lighting around the edge of the higher ceiling uses a double run of 18 mm, 60 ma, 4500° white cold cathode tubing. The cove is used in conjunction with the direct units to convey a sense of height and spaciousness and to reduce the contrast between the surface mounted luminaires and the surrounding ceiling area.

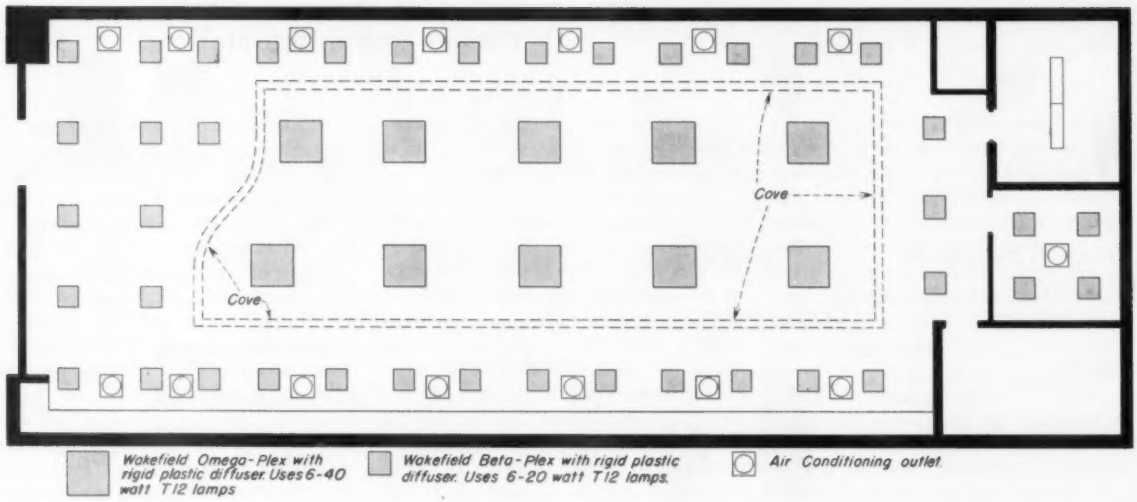
The pendant luminaires above the plant boxes are 150-watt, R-40 Lightcraft units. These were selected to blend with the surroundings and to accent the plant boxes. The perforated reflectors add sparkle and decoration.

All of the lighting equipment is installed on 120-volt branch circuits, making up a total connected load of 15 kw throughout the 4000 sq. ft. of the interior. Average lighting intensity in the area is 65 footcandles maintained. Reflectance factors in the area are as follows: white ceiling—75%; light walnut walls—35%; light green floor—25%; light walnut furniture—35%; yellow and green chairs—35%. Uniform light distribution and the large area low brightness luminaires combined with these good reflectance factors to produce brightness ratios within recommended limits.

Installation required careful fitting due to air conditioning ducts, piping, beams and other elements.

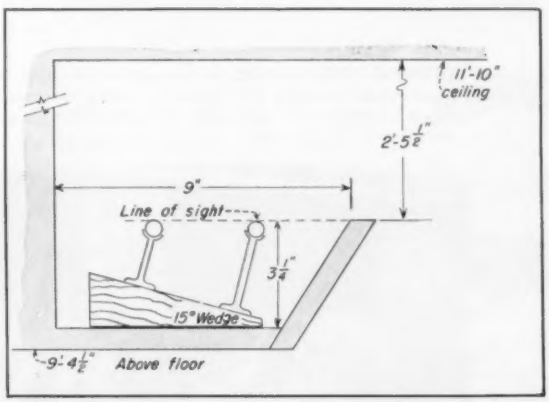
How McClure Electric Company, Dallas, Texas, integrated high lighting intensity and visual comfort conditioning with architectural and decorative designs in an expansive banking-office interior.

WITH PLASTIC DIFFUSERS


Cove
Cove
Wakefield Omega-Plex with rigid plastic diffuser. Uses 6-40 watt T12 lamps
Wakefield Beta-Plex with rigid plastic diffuser. Uses 6-20 watt T12 lamps.
Air Conditioning outlet

LIGHTING LAYOUT for the area shows arrangement of the lighting equipment in the two levels of ceiling above the interior.

RECESSED LUMINAIRE used in lower ceiling exactly replaces four acoustical ceiling tiles and matches the size, shape and finish of the air conditioning outlets which are lined up with the luminaires. Mural at left is lighted by concealed fluorescent strip units.



COVE DETAIL shows how the double run of cold cathode fluorescent tubing is arranged behind the lip of the cove. The wedge was used to adjust the height of the tubes to produce proper distribution and maximum quantity of light on the ceiling, from a completely concealed position.

CODE CONSULTANT Grover Kruecke (seated) clarifies a code regulation for two contractors in the offices of the Milwaukee Electrical Contractors Association. Kruecke is available each morning for telephone or private conferences.

MILWAUKEE HAS

Contractor Code Conferences

with code expert to clarify rules applications and interpretations.

WILL the electrical inspector accept my interpretation of this Code rule, or am I in error? Electrical contractors face this question frequently when designing, estimating and installing electrical systems. The answer should be had at the time the design or estimate is made and definitely before installation is begun. Otherwise, costly consequences may follow.

To resolve such questions and avoid such pitfalls, the Milwaukee Electrical Contractors Association (NECA Chapter) has inaugurated a unique Code Consultation service for its members. Electrical contractors can now telephone the Association offices, or call in person, between 9:00 AM and noon, five days per week and get expert advice in a few minutes. Code consultant Grover Kruecke is on hand to answer any and all questions.

Mr. Kruecke, a retired Milwaukee electrical inspector, was employed by the Association last fall to guide contractors in all code matters. A student of the National, Wisconsin and Milwaukee electrical codes, he is contributing a talent that is used and appreciated by all. To date, contractor consultations (both telephone and personal) average about 135 per month.

Evening Code classes supplement the consultation service. These are open, without charge, to all members, their superintendents and/or estimators. In addition, all electrical inspectors in Milwaukee and surrounding areas have been invited to attend. A number of inspectors are included in the 93 "students" enrolled in the course.

Classes are held at Marquette University in Milwaukee under the competent guidance and instruction of Mr. Kruecke. Because of the large number of registrants, four groups were organized. Each group meets every other week and will attend a total of eight sessions to complete the course. Classes began February 1 and will run through June of this year. Individual sessions comprise one and one-half hours (including a ten-minute break) of concentrated study, instruction and discussion of Code regulations, interpretations and problems. Registrants come away with a more complete knowledge of the Code and a better understanding of rules as they pertain to specific applications.

It is difficult to place a definite dollars-and-cents tag on the value each contractor receives from this Code service. It is a somewhat intangible asset which complements his technical background and enables him to conduct a more efficient operation. One important advantage was apparent, even at the half-way point: Any disparity between inspector and contractor Code interpretation was being narrowed and misunderstanding between the two eliminated.

The consultation service was originated by Chapter manager, E. H. Herzberg. What is being done in Milwaukee may well set the pattern for similar activity in other electrical contractor groups throughout the country.

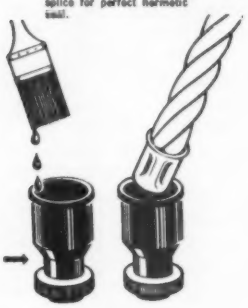
EVENING CODE CLASSES at Marquette University, under instructor Kruecke, are limited to about 25 registrants. Four classes are necessary to handle the 93 "students" comprised of contractors, superintendents, estimators and electrical inspectors.

DATA SHEET

Use of Pressure Connectors

HERMETICALLY SEALED SPLICE

Fill any insulator 1/3 full of insulating liquid and insert splice for perfect hermetic seal.



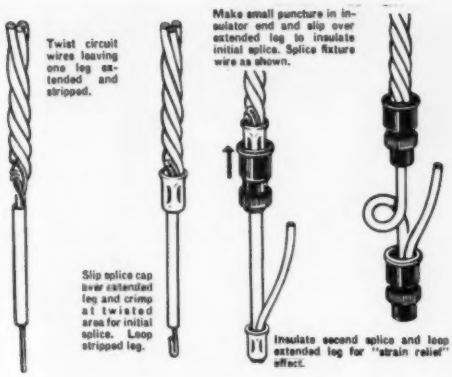
FIXTURE HANGING

Twist circuit wires leaving one leg extended and stripped.

Slip splice cap over extended leg and crimp at twisted area for initial splice. Loop stripped leg.

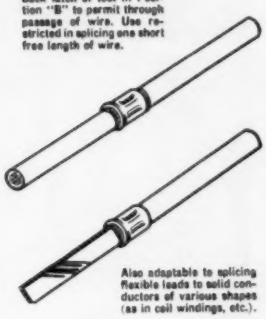
Make small puncture in insulator end and slip over extended leg to insulate initial splice. Splice fixture wire as shown.

Insulate second splice and loop extended leg for "strain relief" effect.



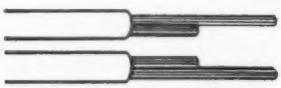
PARALLEL SPLICE

Accomplished by placing back latch of tool in Position "B" to permit through passage of wire. Use restricted in splicing one short free length of wire.

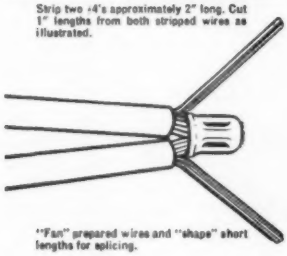


Also adaptable to splicing flexible leads to solid conductors of various shapes (as in coil windings, etc.).

TO SPLICE TWO #4's



Strip two #4's approximately 2" long. Cut 1" lengths from both stripped wires as illustrated.



"Fan" prepared wires and "shape" short lengths for splicing.

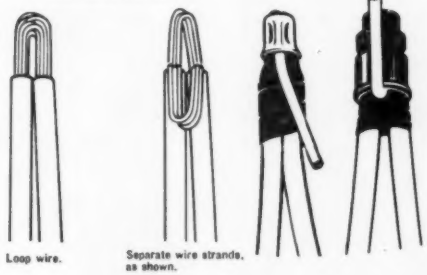
Slip splice cap over short lengths and crimp. Shape long lengths for splicing . . .

Slip splice cap over long lengths and crimp.

REDUCER TAP OFF LARGER WIRE

Untwist natural wire "lay."

Tape strands to wire insulation, splice tap to free loop . . . insulate.



Loop wire.

Separate wire strands, as shown.

STRAIN RELIEF SPLICE

(for service-entrance, etc.)

Strip both wires 2" long and untwist the natural wire "lay". Use large 2011S cap to splice.

Insert second splice cap over stripped wire and crimp. Trim wire ends flush with splice cap.

Insulate with 2012 insulator. Cut "X" in insulator end and position over splice.

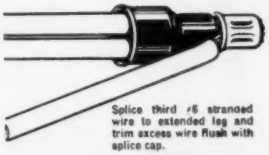
Insulate second splice with insulator.

TO SPLICE 3 OR MORE #6's, ETC.

ILLUSTRATED, SPLICING THREE #6 STRANDED WIRES.

Strip one wire long, use 2011S to make first splice.

Insulate with 2012 insulator. Cut "X" in insulator end and position over splice. Omit locking ring.



Splice third #6 stranded wire to extended leg and trim excess wire flush with splice cap.

Insulate second splice with 2012 insulator.

For more than 3 wires, use additional splice caps and insulators as necessary.

Courtesy Buchanan Electrical Products Corporation

Motor Shops

Coil Puller Speeds Stripping

A shop-assembled, motor-driven coil puller has increased speed and boosted efficiency of motor stripping operations at Queens Electric Motors, Inc., Jamaica, N. Y. With this stripping machine, old coils can be quickly and easily removed from motor stators up to about 25 hp in size. The machine provides a sure, tremendous pull to disengage coils from slots.

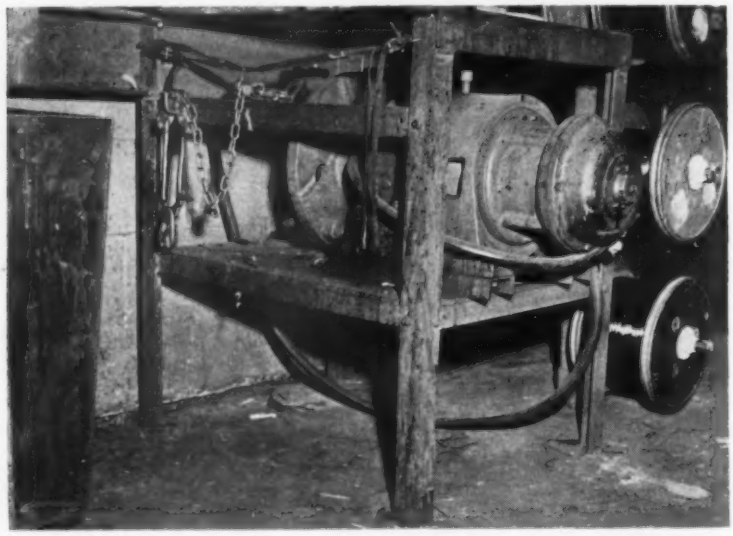


FIG. 1—Coil stripping machine consists of tongs (shown at left) attached to a chain which is connected to the top end of a moving arm (behind big wheel at left end of a gear-head motor). The bottom end of the arm is pivoted and a cam on the motor-driven wheel moves the arm in a slow, back-and-forth motion which is translated into a strong pulling action when coils are gripped.

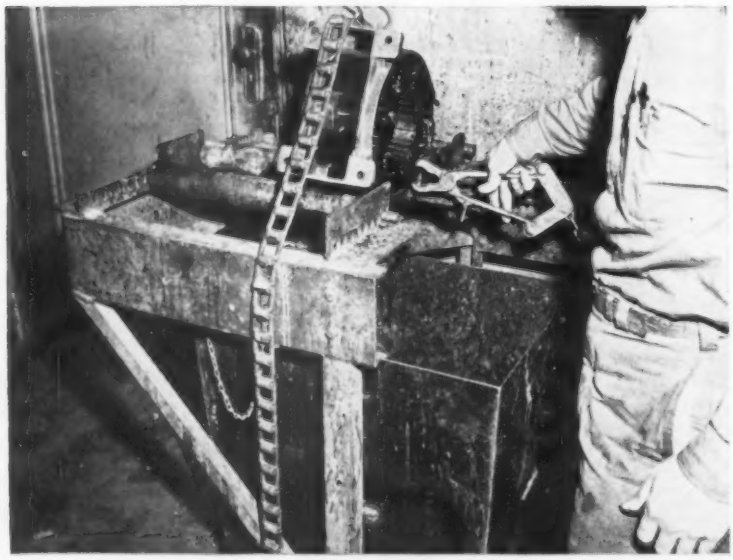


FIG. 2—The motor to be stripped is placed on this special rig and the tongs are gripped onto the coils. When the moving power arm moves away from the motor being stripped, the old coils are quickly and easily pulled out of the stator slots. A chain belt is used to hold the work firmly.

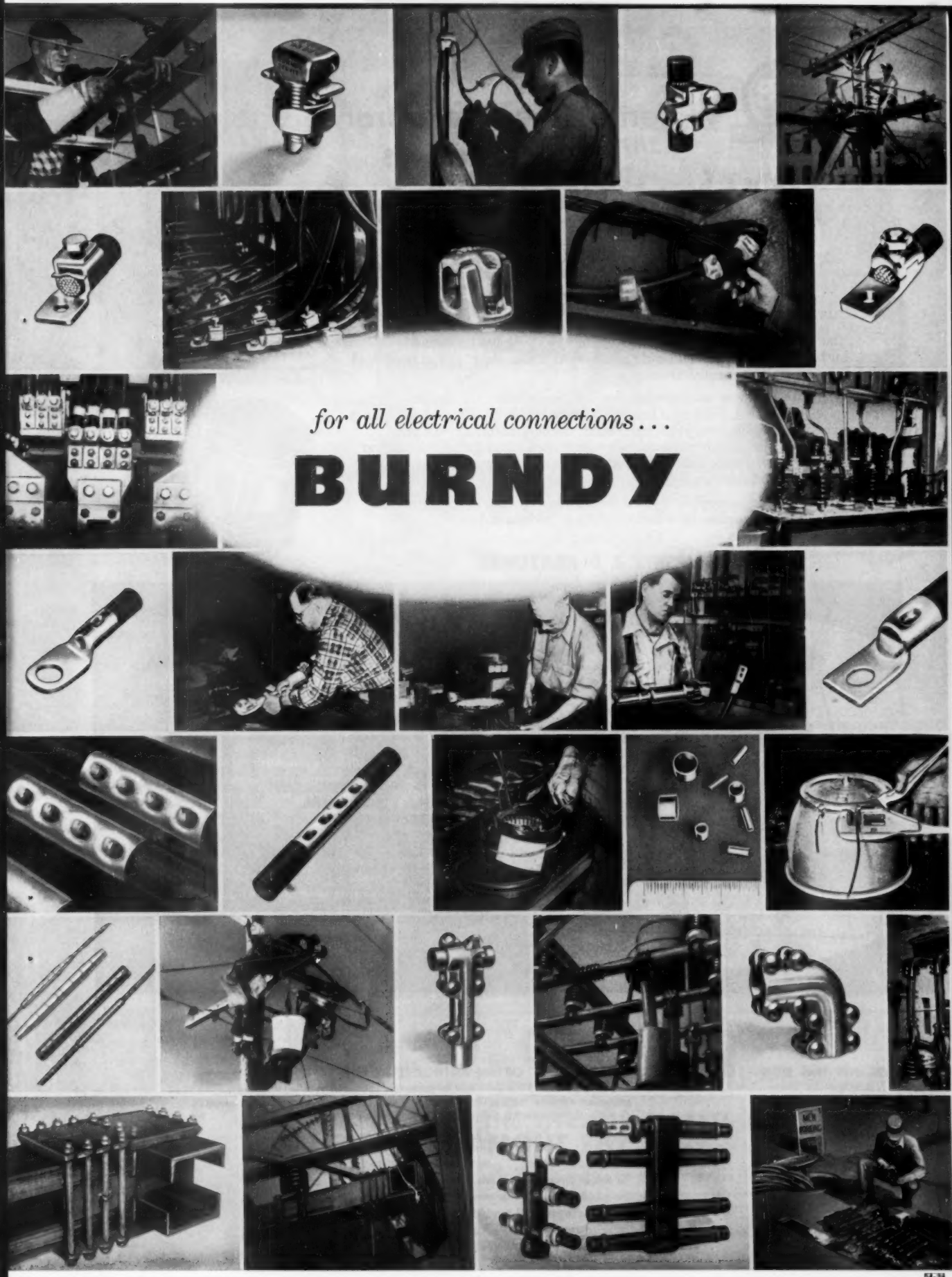
As shown in the photos, the stripping machine consists of two steel-table-mounted assemblies. Figure 1 shows the motor which powers the stripping operation. This is a 3-phase, 3-hp motor with a gear head coupled to a cam arrangement (at left in photo) which provides a slow, powerful back-and-forth swing of an arm pivoted to the steel plate on which the motor rests. The special tongs shown hanging from table brace at left are connected by chain to the top (moving) end of the swinging arm.

Figure 2 shows the second steel-table assembly which is mounted next to the first assembly (the operator is standing between the two assemblies). As shown, the table is a well constructed and rigidly reinforced frame of angle and channel iron. The top is open but is provided with two rollers on which the motor to be stripped can be set. These rollers can be moved further apart or closer together to properly hold whatever size motor is being stripped. When the motor is cradled on the rollers, a chain belt is pulled tightly around it and hooked to hold the motor against the pull of the stripper.

To use the coil stripping machine, the motor to be stripped is chained in place, the moving arm is moved by hand to a starting position at the limit of its travel toward the motor being stripped and the tongs are attached by hand to coil ends and given a good bite into the coils. With the tongs in place, the drive motor is jogged until slack is out of the chain. By controlling the motor through its controller, the moving arm can be made to pull the tongs towards the power table, pulling the coils out as it does. As soon as the tongs have pulled the coil as far as the moving arm and cam will allow, the motor is allowed to run just long enough to return the arm to the starting position, then the motor is stopped. The tongs are then placed, gripping coils which were not pulled out the first time, and the procedure is repeated.

Rolling Rack for Compact Storage

Angles, bars and casters, forming a sturdy steel pyramid, are the elements for a compact and mobile armature storage rack in the shop of



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54-34

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NOW with NEOPRENE Bushings

- **Fit double range of cable sizes**
- **Color-coded for convenience**

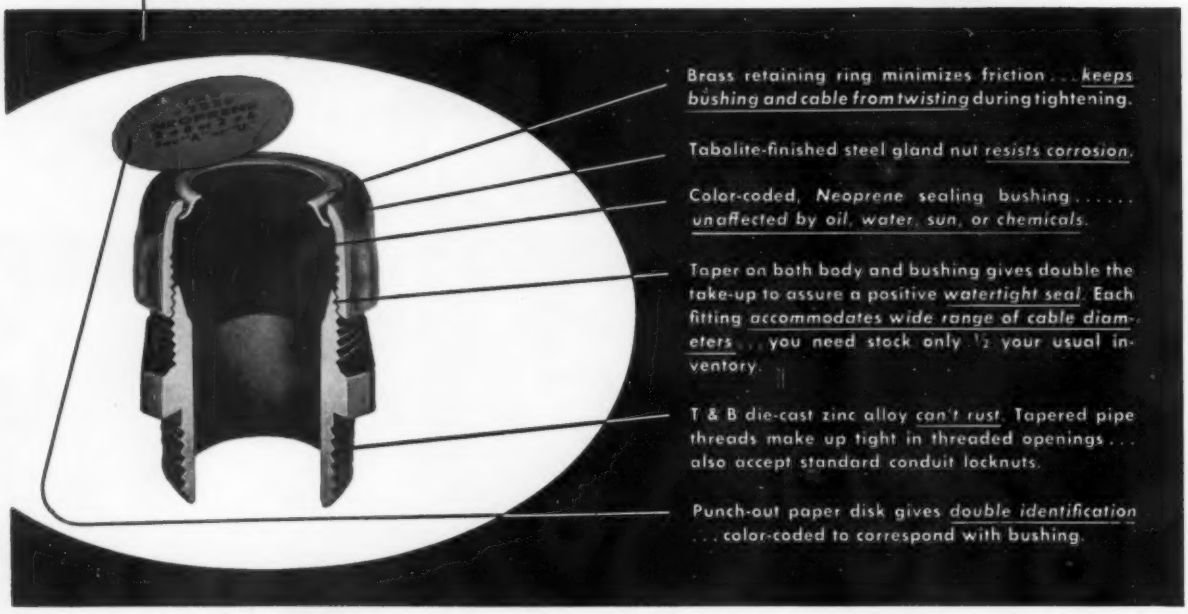
2 styles for complete range of service entrance cables—hex-gland and two-screw...color-coded paper disk and Neoprene bushing.

That's right, T & B watertight SEC connectors now have Neoprene bushings to accommodate a wide range of cable diameters . . . you need stock only one-half your usual inventory.

What's more, these newly-redesigned SEC connectors are *double* color-coded. First, 5 different bright Neoprene bushing colors give at-a-glance size identification even after installation. Second, identically-colored push-out paper discs in same colors are imprinted with catalog number and cable size—there's no time lost through trial-and-error matching of connectors to cable.

Be sure to order a supply . . . you'll always know the size . . . never make a mistake. For complete information, write to address below.

CHECK THESE T & B FEATURES



Brass retaining ring minimizes friction . . . keeps bushing and cable from twisting during tightening.

Tabolite-finished steel gland nut resists corrosion.

Color-coded, Neoprene sealing bushing . . . . . unaffected by oil, water, sun, or chemicals.

Taper on both body and bushing gives double the take-up to assure a positive watertight seal. Each fitting accommodates wide range of cable diameters . . . you need stock only ½ your usual inventory.

T & B die-cast zinc alloy can't rust. Tapered pipe threads make up tight in threaded openings . . . also accept standard conduit locknuts.

Punch-out paper disk gives double identification . . . color-coded to correspond with bushing.

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MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

ROLLING YOUR OWN rack is a practical way to promote efficient storage, identification, armature handling and shop cleanliness, according to workers in the Standard Electric Motor Repair shop in Linden, N J.

the Standard Electric Motor Repair Company of Linden, N. J.

As indicated in the accompanying photo, the four inclined corner posts are made from 6-ft lengths of 2-by-2-by-¼-in. angle stock, spaced 4 ft apart at the bottoms; 1 ft apart at the tops. The horizontal cross arms are formed from 1-by-1-in. angle sections, while L-shaped hangers made from flat steel bar stock slide back and forth along the horizontal members, permitting the accommodation of large and small armatures as required. These sliding L-shaped hangers hold one end of the armatures while the other ends of the shafts are cradled in strap-iron hooks welded as shown on the inclined corner posts.

Mobility is provided by mounting the complete assembly on casters, and this feature permits the pyramid storage rack to be shifted from one work center to another, or to the shipping platform when armatures are being moved in or out of the shop. Since each rack space is identified by a white painted number on the adjacent corner post, and since armatures are also tagged, it is easy to locate any unit positively and quickly. Also, since all armatures are in full view at all times, visible inventory and selection is possible with minimum delay.

"We have several such racks now in use," says NISA member Stan Bojak of Standard Electric, "and we find that they promote compact storage, fast identification, easy handling and greater shop cleanliness." This last item is due to the fact that the racks may be easily moved to permit frequent house-keeping.

THE HIDDEN COSTS ARE OFTEN THE BIG ONES!
SAYS:
A.L. WOODS
Director of Purchases
Wolverine Tube
JIM, SEND THIS ORDER OVER TO THE ELECTRICAL DISTRIBUTORS.
A.L. WOODS
BUT... CAN'T WE SAVE MONEY BY BUYING DIRECT?
WE'RE SAVING NOW--THIS ONE ORDER COVERS LOTS OF ITEMS--ITEMS THAT THE DISTRIBUTOR HAS IN STOCK LOCALLY.
IT'S SAVING YOU A LOT OF PAPER WORK NOW AND LATER ON WHEN THE INVOICES COME IN AND FURTHERMORE...
THE DISTRIBUTOR ABSORBS ALL THE COSTS OF DEPRECIATION, OBSOLESCENCE, HANDLING, INSURANCE, TAXES, AND STORAGE.
I SEE WHAT YOU MEAN. WE'D HAVE TROUBLE JUST WAREHOUSING ALL THIS STUFF.
NOT ONLY THAT, BUT THE DISTRIBUTOR BUYS A WIDE VARIETY OF ITEMS IN QUANTITY AND PASSES ON THESE SAVINGS TO US.
AND DON'T FORGET, IF ANYTHING GOES WRONG HE'S RIGHT HERE TO HELP STRAIGHTEN IT OUT OR MAKE GOOD--HE DOES A LOT TO EARN HIS PROFIT.

"Remember in emergencies or for everyday electrical needs, it pays to call your local T&B distributor — he saves and serves by simplifying your purchasing problems and reducing your costs."

In keeping with our policy of selling solely through Electrical Wholesalers, we are pleased to sponsor the above message on behalf of T&B distributors throughout the nation. T59

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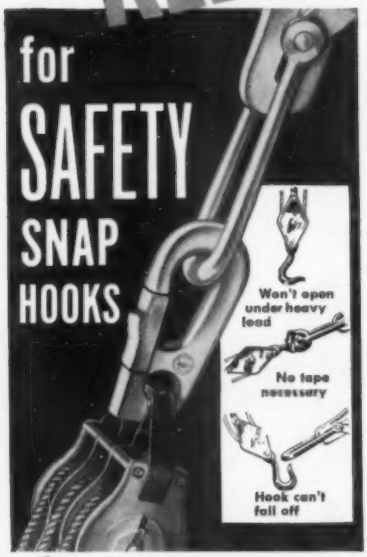
Look to the Leader

KLEIN

for SAFETY SNAP HOOKS



455 Solid Eye

Here's strength, safety on heavy loads—for blocks, tackles and hoists. Klein Safety Snap Hooks are time savers, too, eliminating the necessity of taping or wiring the throat. Made of drop forged steel—carry a working load of 8,000 pounds with adequate safety factor. Snap on easily with one hand—may be used on any conventional steel block 6 inches or smaller, or on chain hoists or snatch blocks. Four types regularly available. Specify 455-SH-3 Snap for use with 1½-ton hoists... No. 455-SP for double chain hoists and for attachment at housing. Klein can also supply safety snap hooks for lighter loads.

455-S Swivel Eye

455-SH Swivel Eye

Foreign Distributor: International Standard Electric Corp., New York

455-SP

Write for your free copy of the Klein Pocket Tool Guide today!

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Ball Thrust for Pulling Pulleys

From one of our readers in England (Clifford T. Bower of London) comes the suggestion that a compact, simply constructed ball-thrust device, designed to accommodate pulleys up to about 2½ inches in diameter, can be of considerable assistance when withdrawing pulleys from the spindles of fractional horsepower motors.

The device consists essentially of a steel yoke or frame, containing two slotted holes to receive hooked bolts, and a central threaded hole for the main drive screw. The hooked ends of the bolts are placed behind the lip of the pulley being pulled, and the distance between the bolt heads may be varied by sliding the bolts inwards or outwards in the elongated yoke slots.

As indicated in the accompanying diagram, each hook bolt is fabricated from a standard ⅜-in. square-headed bolt; the head being sawed and filed to the desired shape, thereby removing the surplus metal, as shown. This is indicated in Detail "A".

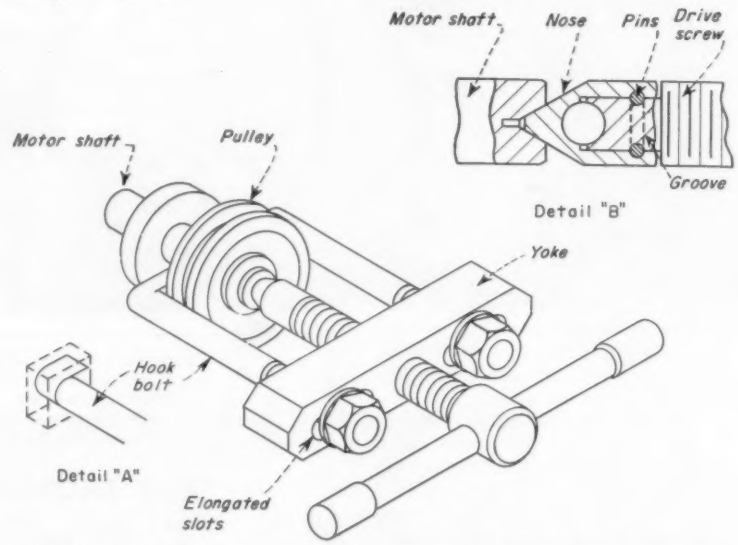
Another feature of the pulley-pulling tool is the friction-reducing ball-thrust bearing which is incorporated in the tapered shaft-pressing end of the threaded drive screw. A cross section of this ball-thrust, shown in Detail "B", reveals the conically shaped thrust which is hollowed internally. The sketch also shows the position of a hardened steel ball which is contained in the drive-screw end socket, and which separates the interior faces of the screw and the false nose. Both of these interior faces are hollow ground to provide a proper seating for the ball.

It will be noted that the conical end of the false nose is not taken to a sharp point, but ends in a flat drive pin arrangement. The cone is machined accurately at an angle of 60 degrees, thereby fitting neatly into the standard center holes of motor shafts without distorting them. This provision of the ball thrust greatly minimizes damage which a complete pointed taper might otherwise inflict upon the center holes.

In use, the false nose remains stationary while the drive screw is rotated. This prevents the center hole in the shaft from being scored, and it is a definite improvement over the standard type pulley ram which has a pointed head that revolves with the drive screw. This former device usually scored the center holes of the shaft, distorting them and making it difficult to accurately align the shaft on the true center of a lathe should it be necessary.

The low friction coefficient of the ball-thrust makes it easier to turn the pulley-puller handle under pressure. It also makes it unnecessary to lock the motor shaft to prevent it from revolving with the drive pin during the process of withdrawing the pulley from the motor.

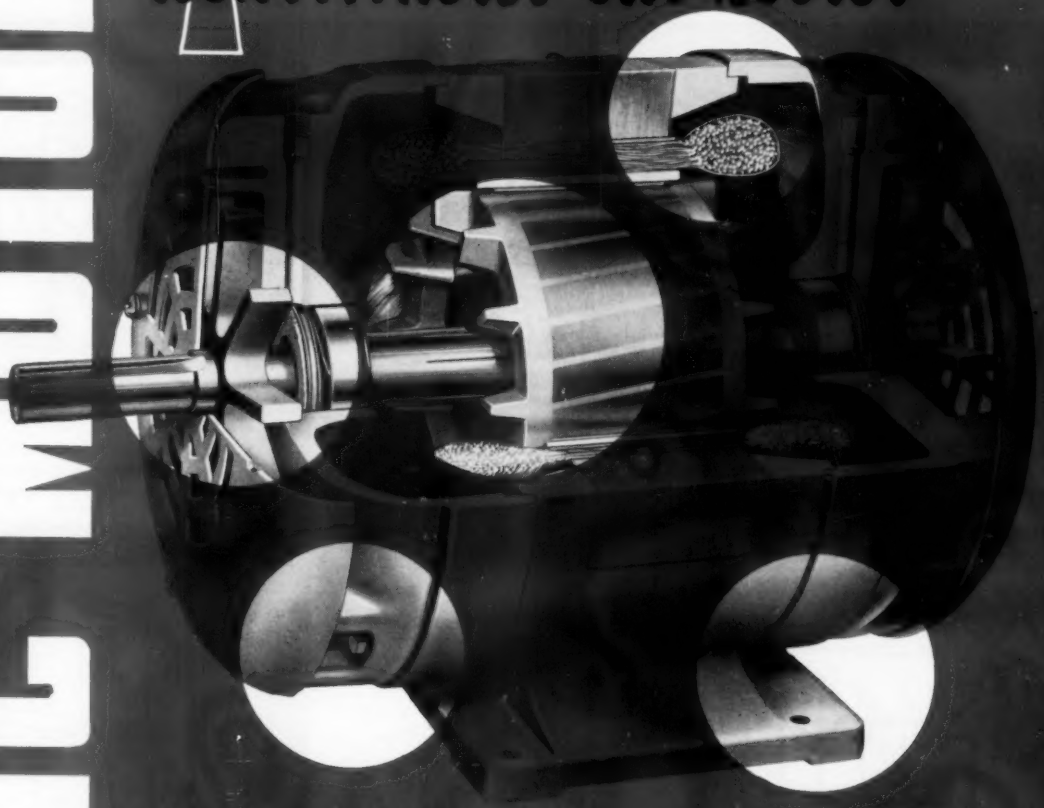
Existing pulley-pullers may be modified to accommodate a ball-thrust bearing. This may be done by keeping the false nose in place by means of two small-diameter pins, driven into holes drilled tangentially through the nose, as also indicated in Detail "B". These pins engage with a circumferential groove, machined in the screw end, as shown.



TAPERED DRIVE PIN, elongated yoke holes and hooked-end bolts are features of this compact pulley-pulling device designed to facilitate removal of sheave from shaft of small motors.

BALDRIC MOTORS

look....here's our secret



The new *Streamcooled* Baldric line of fully enclosed motors are better because they bring you powerhouses in a more compact package. And this cutaway drawing shows you how our engineers combined the newest developments and newest materials to get more motor into less bulk. The *Streamcooled* Baldric line doesn't waste an inch or an ounce. These motors are easier to install, easier to handle . . . bring you modern efficiency and performance.

See how the rugged Unicast stator frame combines steel laminations in an aluminum alloy casting to get greater stability, rigidity. Improved insulation permits better slot design for copper windings. Improved techniques produce balanced, stress-free rotors. *Every* detail of design and construction is calculated to reduce size and weight without sacrificing performance and efficiency.

And Baldor has done just that. Built a better motor. *Streamcooled* Baldric's your best bet . . . doesn't waste space . . . doesn't waste weight . . . easier to handle and install.

Original *Streamcooled* Baldor Motors Available — Built to Former NEMA Standards

BALDOR ELECTRIC COMPANY

Baldric Motors Are Available in Polyphase • Squirrel Cage Induction and Single Phase • Capacitor Start • Induction Run Types

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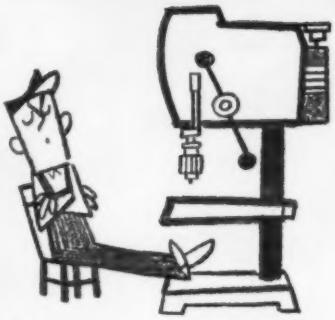
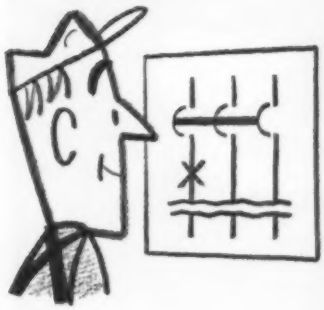
10 reasons why it's wise to buy

1 They offer the highest degree of personnel protection. Live parts are covered, even when enclosure cover is open.

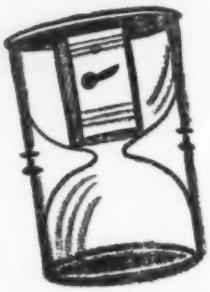


2 They reduce production downtime. No time is lost locating or replacing fuses. Breaker can be reset as soon as fault is cleared.

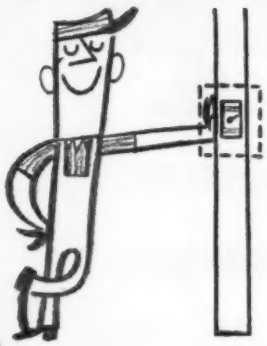
3 They eliminate replacement costs and maintenance. First cost is the last. No replacement parts or fuses are needed.



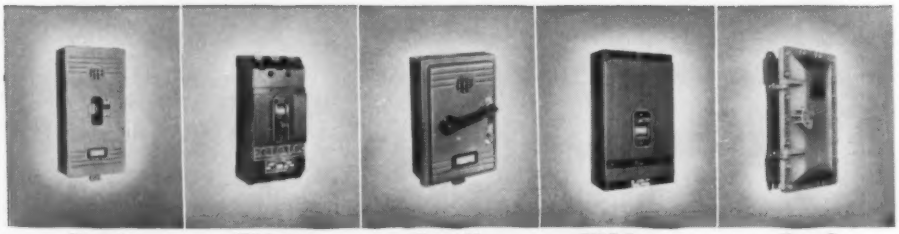
6 They prevent possible single phasing when a fault occurs. All poles trip simultaneously.



7 They safely carry continuous current rating indefinitely. Breakers must carry 100% of load indefinitely without exceeding temperature limits.



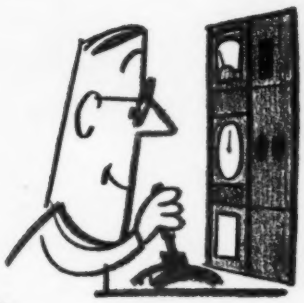
8 They save mounting space. Require less space than same rated enclosed fusible switch.



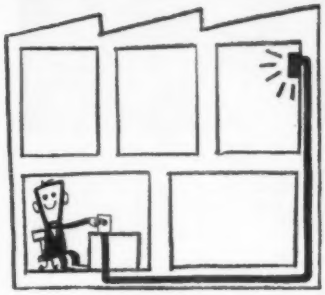
Nema 1 Enclosure | "F" Frame Breaker | Nema 1A Enclosure | "KL" Frame Breaker | Nema 7 Enclosure

I-T-E Circuit Breaker Protection

4 They are completely tamperproof. Breaker is calibrated and sealed at the factory.



5 They are twice-tested individually at the factory to insure uniformity of operation in the field.



9 They can be equipped with internally mounted auxiliary devices for under-voltage protection, remote tripping and indication of circuit condition.

10 They incur low watts loss. Welded connections and silver alloy contacts provide low watts loss throughout the life of the breaker.

I-T-E Molded Case Circuit Breakers are rated through 600 volts a-c, 250 volts d-c, 10 through 600 amp. I-T-E also supplies a complete line of enclosures for all applications. Contact your I-T-E representative or authorized distributor for the Speedfax Catalog. Or write Small Air Circuit Breaker Division, I-T-E Circuit Breaker Company, 19th and Hamilton Sts., Philadelphia 30, Pa.

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THE EDWIN F. GUTH COMPANY
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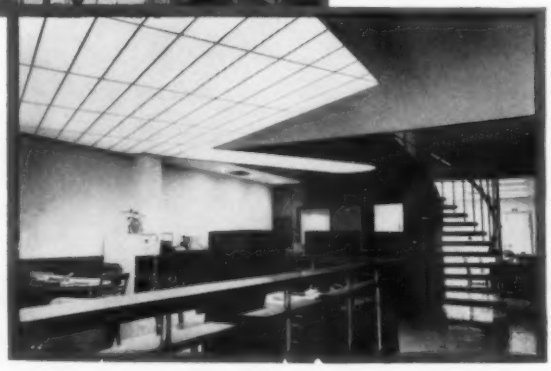
May we send you detailed information and layout guide FREE?



DODGE AGENCY GEN. OFFICE, SALINA, KAN.

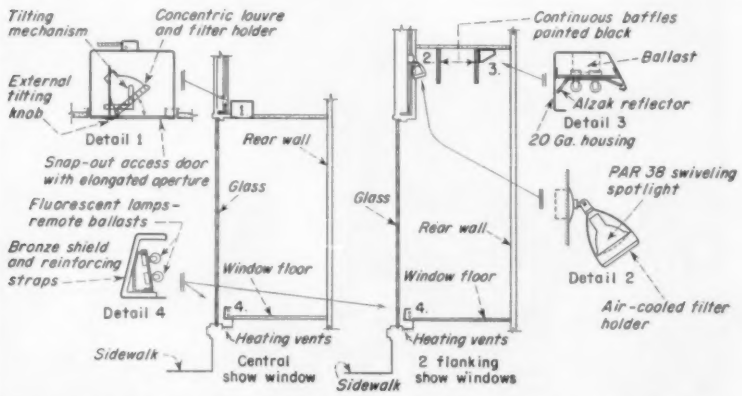
Modern Lighting

Four Mediums for Show Window Lighting

Two different lighting techniques are used satisfactorily to illuminate street-level show windows in the Rogers Peet clothing store at 600 Fifth Avenue, New York City. The first of these methods involves the overhead installation of ceiling-recessed Gotham monopoint control Accentlites, plus a continuous 2-row fluorescent lamp trough extending along the front lip of the window's floor just inside the glass line. The second technique utilizes the same floor trough for bottom lighting, but obtains overhead illumination partly from PAR-38 Swivelier units fitted with air-cooled filter holders, and partly from a continuous 2-row fluorescent unit equipped with Alzak aluminum reflectors.

Shields for floor troughs (Detail 4, sketch) are of bronze, while brackets supporting the holders for rapid-start lamps are inclined slightly from the vertical in order to direct light upwards towards merchandise on display. Because of space limitations, ballasts for these units are mounted remotely, and control of circuits is by time switch.

MONOPOINT CONTROL ACCENTLITES in ceiling may be rotated 358 degrees, if desired, and tilted from the vertical to angles up to 45 degrees. Apertures in cover plates are elongated to permit passage of full effective light beams, while edge baffles and concentric louvers trap spill light.



CROSS SECTIONS through show windows of Rogers Peet store shows location and detail of four lighting mediums. Front floor and rear ceiling coves are for fluorescent lamps, while adjustable spot units located directly inside glass lines are equipped with incandescent reflector lamps.

The monopoint Accentlites (Detail 1) have provisions for both horizontal rotation and vertical tilting, facilitating accurate and fast beam adjustment with minimum effort. Tilting is accomplished by means of external control knobs that protrude downwards from the tilting mechanisms through the bottom cover plates of the fixtures, rotation of these knobs activating a worm pinion that moves lamp alignment from the vertical to inclinations up to 45 degrees. Horizontal rotation of the unit is obtained manually, with the axis of the light beam permanently aligned at all times with the center line of an elongated aperture in the cover plate.

In the Accentlite units, spill light is trapped by edge baffles as well as by concentric louvers. Louvers also serve to hold heat-resistant color filters in place. Units are installed flush with ceiling panels and are painted to blend inconspicuously into these upper surfaces.

Where Swivelier units are used, they are mounted directly to standard outlet boxes (Detail 2) located on 16-inch centers 3 feet above the lower edges of upper proscenium sills. Ten of these units are so used in each 14-ft show window.

Where overhead Alzak aluminum reflectors are installed (Detail 3) they are mounted behind continuous black-painted wooden baffles positioned 1 ft, 6 in. from rear curtain walls. Illumination from these units brightens window backgrounds, giving additional visual impact to the displays. As in floor units, lamps are 40-watt T-12 rapid-start fluorescents, although in these instances ballasts are incorporated into the 20-gauge white enameled housings since there is ample room for them.

These window techniques represent the cooperative efforts of architects Carson and Lundin, interior designer Raymond Loewy, electrical consultants Smith and Silverman, and electrical contractor J. Livingston & Co., all of New York City.

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★ New type heavy duty, all steel, all chrome reflector with swing-open guard.

★ Heavy gauge steel casing... smartly styled with a strikingly new textured finish... grease and oil resistant and set off by gleaming chrome trim.

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Shoe Store Uses 6-ft Round Fluorescent Units

Designers have long been limited in their use of fluorescent lighting for small shops by the long and narrow shape of fluorescent luminaires. Whether mounted crosswise or along the store's normal axis, they emphasize one dimension of the interior and tend to diminish the other. This can be a serious disadvantage, particularly in narrow shops.

A suitable solution to this problem has been obtained through the development of large surface area fluorescent assemblies. This style of unit, available in circular or rectangular shapes, does not detract from the depth of a shop nor does it point up a lack of width.

Architect Olindo Grossi employed this technique to good effect in the French Shriner shoe store located in New York's Rockefeller Center. Three round recessed units form the focal point of an efficient but unobtrusive lighting system. Each assembly houses 14 40-watt and four 20-watt fluorescent lamps. The units, which are called Gruber Plexlites, feature a Plexiglas diffuser that is protruded slightly below the ceiling plane to obtain wider distribution of light and to minimize contrast between the fixture surface and adjacent ceiling areas. The Plexiglas diffuser transmits 85% of the lamp output.

The diameter of these units is six feet. As compared with the store's lateral dimension of 19 feet, this fixture width tends to broaden the store's appearance without conflicting with the essentially longitudinal lines of the interior.

Complimenting the fluorescent light sources is an installation of incandescent high-hat units which form three squares surrounding the fluorescent assemblies. These recessed downlights employ R-40, 150-watt reflector flood lamps with concentric ring louvers to minimize brightness when viewed from the side.

The light intensity delivered by this system varies from 50 ft-c along the floor perimeter to more than 75 ft-c beneath the main lighting assemblies. This high level was desirable from two standpoints: proper display and examination of merchandise required it; and, secondly, nearby shops along both the arcade and street sides of the store are so brightly lighted that French Shriner had to have a high intensity system to compete for shoppers' attention.

For this latter reason the show windows on the arcade and street ends of the store receive high concentrations of light derived from a combination of sources. Although the exact arrangement of lighting units varies in all four windows according to structural conditions, the basic system utilizes a 3-lamp recessed slimline fixture with water white, low surface brightness glass diffusers, a row of 150-watt R-40 floods and another row of similar spots. Because of a low, narrow header in the arcade windows, bracket type bullet units were used in the back row.

LARGE FLUORESCENT ASSEMBLIES create feeling of spaciousness in this small shoe shop. Each unit contains 14 40-watt and four 20-watt lamps, has domed Plexiglas diffuser for widest possible distribution of light.

FROM THIS

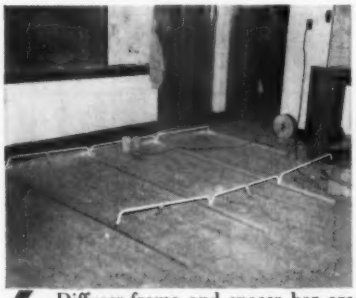
1 This 27-year old classroom which has an illumination level of 15 footcandles is about to be transformed. First step was to repaint it light colors for better reflectance. Now follow the succeeding steps, which were all accomplished in 4 hours.

2 Step two was the mounting of the first Photo-Metric channel at the front of the room.

3 The second Photo-Metric channel is in place and conduit spacer has been quickly installed.

4 After channels are mounted, wiring from terminal blocks through conduit spacers is completed.

5 After existing electrical outlet is tapped, lamps are inserted and tested by being turned on.

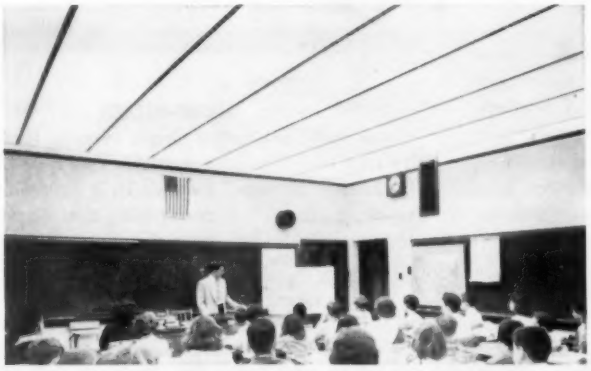


6 Diffuser frame and spacer bar are assembled on floor, ready for mounting in hook-on points at sockets.

7 Adjoining diffuser frames are assembled together to complete the diffuser grid.

8 Wākon diffusers are unrolled, pulled through diffuser channel, and held at ends by spring clamp.

TO THIS



9 A complete diffuser installed, high level illumination provided, excessive brightness ratios reduced, ceiling cracks and surface wiring covered, and a visual environment designed for learning gained all in four hours installation time.

IN 4 HOURS

WITH

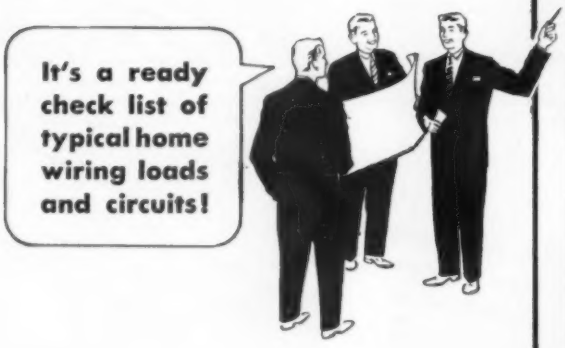
WAKEFIELD PHOTO-METRICS

Write for the booklet, Wakefield Lighting: As Flexible As Your Classrooms.

THE WAKEFIELD COMPANY
Vermilion Ohio

WAKEFIELD LIGHTING LIMITED
London Ontario

Get this FREE Home Wiring Wall Chart!



You'll want to post this handy and practical chart on the walls of your offices or estimating rooms. Wherever it's used, you'll find it a valuable check list when you're planning home electrical systems.

AUTHORITATIVE!

The wiring facts shown by this chart were worked out in collaboration with leading electrical contractors and modern adequate wiring experts. You can be sure of the facts it contains.

Typical loads and circuits for kitchen, laundry, living areas and fixed utilities are shown. Also typical power center and circuit requirements for a six-room house.

LOAD AND CIRCUIT

KITCHEN

	Typical Wattage	Preferred Circuit	Volts	Wires	Breaker or Fuse	Number Outlets
RANGE	12000	10 KW.	120/240	3 #6	50A. 60A.	1
OVEN (Built in)	4500	6 KW.	120/240	3 #10	30A.	1
RANGE TOP (Heavy Duty)	6000	6 KW.	120/240	3 #10	30A.	1
RANGE TOP	3300	4 KW.	120/240	3 #12	20A.	1 or more
DISHWASHER	1200	2 KW.	120	2 #12	20A.	1
WASTE DISPOSER	300	2 KW.	120	2 #12	20A.	1
BROILER	1500	2 KW.	120	2 #12	20A.	2 or more
FRYER	1300	2 KW.	120	2 #12	20A.	2 or more
COFFEEMAKER	1000	2 KW.	120	2 #12	20A.	2 or more
REFRIGERATOR	300	2 KW.	120	2 #12	20A.	2
FREEZER	350	2 KW.	120	2 #12	20A.	2

LAUNDRY

	Typical Wattage	Preferred Circuit	Volts	Wires	Breaker or Fuse	Number Outlets
WASHING MACHINE	1200	2 KW.	120	2 #12	20A.	1
DRYER	5000	6 KW.	120/240	3 #10	30A.	1
IRONER	1650	2 KW.	120	2 #12	20A.	1
HAND IRON	1000	2 KW.	120	2 #12	20A.	2 or more
WATER HEATER	3000					

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It's a real king-sized chart, twenty inches deep by two feet, 3½ inches wide. You'll find its large type easy to read. Printed in 2 colors on heavy stock, it stands up under long use. Send coupon for your FREE copy today!

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CHART FOR HOME WIRING SYSTEMS

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Typical Outlets	Notes
	Use of more than one outlet is permitted, but not recommended.
	Appliance may be direct connected.
	Appliance may be direct connected.
	These appliances may be direct connected on a single circuit. Grounded receptacles required, otherwise.
	Heavy duty appliances regularly used at one location should have a separate circuit. Only one such unit should be attached to a single circuit at a time.
	Separate circuit serving only refrigerator and freezer is recommended.

	Notes
	Grounding type receptacle required.
	May be direct connected—must be grounded.
	Grounding type receptacle required.
	Consider possible use in other locations.
	Consult Utility Co. for load requirements.

LIVING AREAS

	Typical Wattage	Preferred Circuit	Volts	Wires	Breaker or Fuse	Number Outlets	Typical Outlets	Notes
WORKSHOP	1500	2 KW.	120	2 #12	20A.	2 or more		Separate circuit recommended.
PORTABLE HEATER	1300	2 KW.	120	2 #12	20A.	1		Should not be connected to circuit serving other heavy duty loads.
TELEVISION	300	2 KW.	120	2 #12	20A.	2 or more		Should not be connected to circuit serving appliances.
PORTABLE LIGHTING	1200	2 KW.	120	2 #12	20A.	2 or more		Provide one circuit for each 500 sq. ft. Divided receptacle may be switch controlled.

FIXED UTILITIES

	Typical Wattage	Preferred Circuit	Volts	Wires	Breaker or Fuse	Number Outlets	Typical Outlets	Notes
FIXED LIGHTING	1200	2 KW.	120	2 #12	20A.	2 or more		Provide at least one circuit for each 1200 watts of fixed lighting.
AIR CONDITIONER ¾ H.P.	1200	2 KW.	120	2 #12	20A.	1 or more		Consider 4 kw 3-wire circuits to all window or console type air conditioners. Outlets may then be adapted to individual 120 or 240 volt machines.
AIR CONDITIONER 1½ H.P.	2400	4 KW.	120/240	3 #12	20A.	1 or more		
CENTRAL AIR CONDITIONER	5000	6KW.	120/240					Consult manufacturer for recommended connections.
SUMP PUMP	300	2 KW.	120	2 #12	20A.	1 or more		May be direct connected.
HEATING PLANT	600	2 KW.	120	2 #12	20A.	1		Direct connected. Some local codes require separate circuit.
BATHROOM HEATER	1500	2 KW.	120	2 #12	20A.	1		Direct connected.

TYPICAL POWER CENTER AND CIRCUIT REQUIREMENTS

6 ROOM HOUSE 1500 sq. ft.

20-kw Service	main	100 amp 3w	240/120 volts	Dish Washer	1-2 kw	20 amp 2w	120 volts
10-kw Range	1-10 kw	50 amp 3w	240/120 volts	Oil Burner	1-2 kw	20 amp 2w	120 volts
3-kw Water Htr.	1-6 kw	30 amp 3w	240/120 volts	Freezer-Ref.	1-2 kw	20 amp 2w	120 volts
5-kw Dryer	1-6 kw	30 amp 3w	240/120 volts	Heater	1-2 kw	20 amp 2w	120 volts
1¼-hp Cooler	1-4 kw	20 amp 2w	240 volts	T.V.	1-2 kw	20 amp 2w	120 volts
Clothes Washer	1-2 kw	20 amp 2w	120 volts	General Purpose	4-2 kw	20 amp 2w	120 volts
Ironer	1-2 kw	20 amp 2w	120 volts	Portable App.	3-2 kw	20 amp 2w	120 volts

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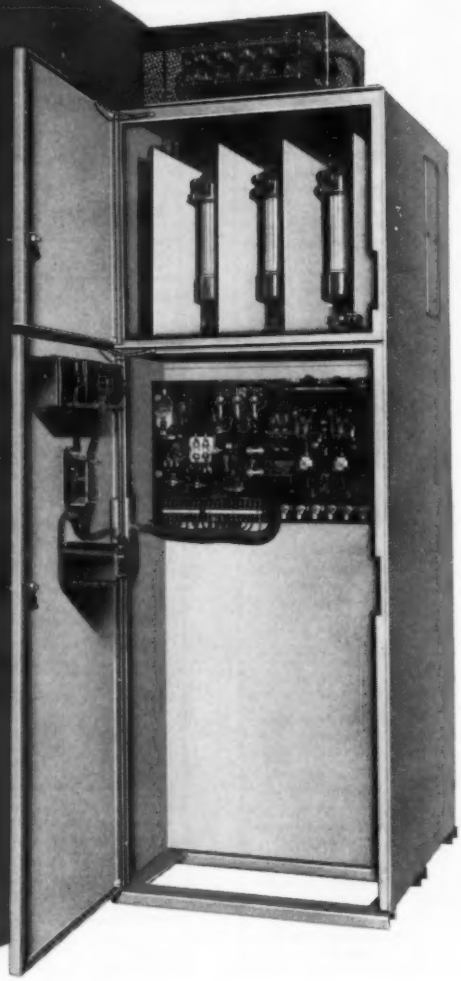
Small ... Large and all sizes in between



The Allis-Chalmers line extends from small manual starters for fractional horsepower motors through starters applied in controlling up to 2500-horsepower motors. Built into every control is the type and degree of protection required to meet your specific needs. Control functions, varying with application, include full or reduced voltage starting, acceleration, speed control, reversing or non-reversing, and dynamic braking.

Application Help

An Allis-Chalmers recommendation is backed by the experience gained in solving thousands of control application problems . . . by complete research and testing facilities. Get all the facts. See your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4722

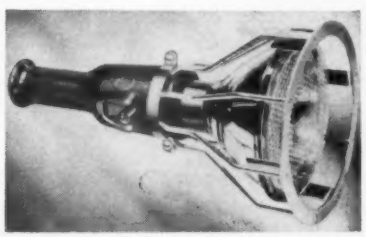
ALLIS-CHALMERS

Product News

Motors (1)

A new instantly-reversible fhp motor especially designed for use on door operators, machine tools, cranes and hoists. Motor has a large, built-in, 5-stud terminal board with reversing connection diagram on inside of terminal box cover. A high voltage capacitor helps start and reverse heavy loads. Sizes are ¼, ⅓, ½ and ¾ hp. Motors are available in 115- or 230-volt, single voltage ratings, and operate at 60 cycles, 1725 rpm.

General Electric Company, Schenectady 5, N. Y.



Lamp Guards (2)

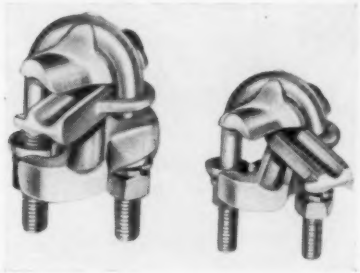
New portable lamp guards have been designed for industrial uses. Available with handles of rubber, phenolic or wood. The back of the long life lamp is silvered and extra-heavy steel wires form a protective cage. Steel wires are welded and zinc-plated. Portable models also stay put when set on a flat surface. Available in 75- and 150-watt sizes.

McGill Manufacturing Co., Inc., Valparaiso, Ind.

Substations (3)

Redesign of single-circuit unit substations having a low voltage of 5 kv or less has been announced. Equipment features meters, recording instruments and control panels located in a safe, dead front compartment which is easily accessible behind a front weatherproof door. Current transformers, transformer secondary connections, bus work, and internal terminations are located behind the hinged doors. A standard bus structure and arrangements for either 50-or 150-mva size unit enable users to modify equipment for higher breaker ratings. Panel sizes of redesigned single-circuit unit substations have been standardized and a single arrangement permits inclusion or omission of the by-pass switch.

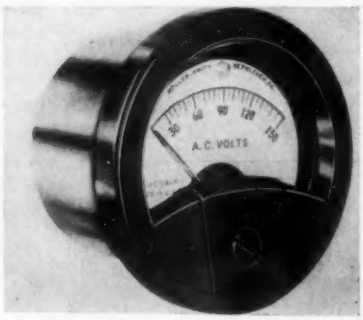
Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.



U-Bolt Clamps (4)

U-bolt clamps of a hinged type are made of corrosion-resistant, high-strength aluminum alloy. Two clamps are available—one designed to accommodate conductors in sizes from No. 6 ACSR to 2/0 ACSR, and the other from 2/0 ACSR to 336.4 MCM ACSR. The angular position of the galvanized steel U-bolt with respect to conductors exerts a uniform clamping force on the conductors. The force is of sufficient magnitude to hold conductors to loads in excess of their rated tensile strength without slippage.

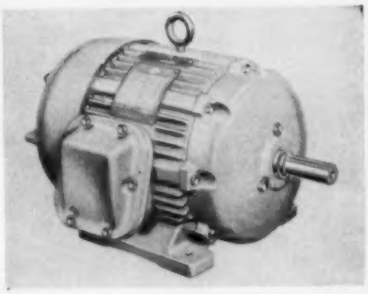
Line Material Company, 700 W. Michigan St., Milwaukee 1, Wis.



Instruments (5)

A new line of ac ruggedized instruments designed to provide maximum readability, accuracy, and maintenance simplicity. They are available in 2½-in. and 3½-in. hermetically sealed cases and conform to specifications MIL-M-10304 (Sig. C.). Case design features new modern styling and matches all other panel instruments in this line.

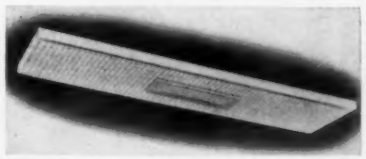
Roller-Smith Corp., Bethlehem, Pa.



Motors (6)

A new line of electric explosion-proof motors carry Underwriters' approval for use in all Class I, Group D, and Class II, Groups E, F, and G hazardous locations. They are available in ratings of 1 to 25 hp, 3-phase, and 1 to 3 hp single phase. Modifications of the 3-phase motors are also available with Underwriters' approval for use in Class I, Group C, hazardous locations.

Louis Allis Co., Milwaukee 7, Wis.



Fluorescent Luminaire (7)

The Thin-Lite series of fluorescent luminaires has a depth of 2⅝-in. and creates a semi-recessed effect, although surface-mounted to ceiling. The series consists of four different luminaires. Two are 49-in. in length (equipped with 48-in. rapid start lamps), and two units are 97-in. long (equipped with 96-in. 430 ma lamps). In each length there is a 2-lamp model, 12¼-in. wide; and a 4-lamp model, 26¾-in. wide. They may be mounted end to end or side by side. Bolt knockouts are provided, and backplate is recessed so that fixtures can be drawn up against the ceiling. The Styron louver panels are metal framed and are secured by floating hinge. Literature is available.

Lighting Products Inc., Highland Park, Ill.

Power Drive (8)

For power operation of hand pipe tools, a light-weight power drive on a new type folding tripod with integral tray, named the Ridgid No. 200. Unit is equipped with speed chuck. Power unit alone can be bolted to bench or truck, is equipped with pipe benders and slots for hanging tools. Capacity, 1/9-in. to 2-in. pipe or conduit, ¼-in. to 2-in. pipe or conduit, ¼-in. to 2-in. bolts.

Ridge Tool Company, Elyria, Ohio.

midwest MW

PERMANENT-MOLD *Cast Connectors* FOR POSITIVE INSTALLATIONS

APPLICATION:

Catalog number 722V for armored cable and flexible steel conduit. Catalog number 759 for non-metallic cable.

PRODUCT DETAIL:

The armored cable connector embodies conventional offset chamber design; the screw has a large head for easier tightening.

The contour of the clamp on the non-metallic cable connector conforms to the curve of the body of the fitting, to insure a positive hold on the cable. The deep indentation on the clamp makes the fitting adaptable to a wide range of cable types.

Both connectors are reinforced at the cable entrance end for extra strength.

SIZE:

Connectors are standard trade size ⅜", for ½" threaded hub or knockout.

★ Here is another Midwest development in providing quality fittings. "Quality" is just a condensed way of saying: "Getting the total job done—right—with the most inexpensive combination of material and man hours." Engineering and producing quality fittings to meet the highest standards of electrical wiring installations, is our objective at Midwest.

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

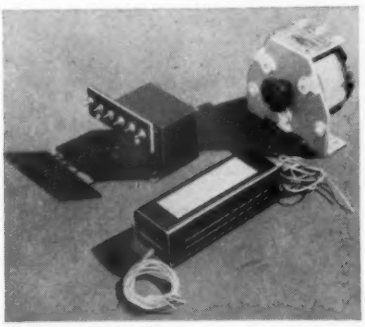
1639 W. WALNUT STREET

Chicago 12, Illinois

Lighting System (9)

A complete lighting system for specific use at hazardous areas (Class I, Groups A and B) where acetylene and hydrogen are present. System consists of the following UL-approved components: 150-and 200-watt EVA 295 pendant lighting fixtures, EAB junction boxes, FSPC tumbler switches, EYS seals, UNY unions, and EC series flexible couplings and flexible fixture hanger supports. System's individual units are similar in appearance and size to other C-H explosion-proof fixtures and fittings for Class I, Groups C and D locations. The new pendant fixtures take 150-watt PS-25 and 200-watt A-25 or PS-25 lamps, and are available with or without globe guard and 30-degree, dome, deep or shallow bowl reflectors.

Crouse-Hinds Company, Wolf and 7th North Sts., Syracuse, N. Y.



Dimming System (10)

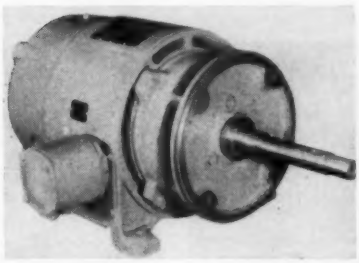
A new dimming system for hot cathode fluorescent lamps is recommended for the control of fluorescent cove lighting, luminous ceiling and multiple lamp fixtures. Features are—dimming range of 750 to 1 in intensity; non-electronic; works equally well with new or old lamps; single dimmer can handle one to 160 40-watt lamps. Components in system include: an auto-transformer dimmer and auxiliary transformer for one or more lamps, and a specially designed ballast (one required for each lamp). System is designed for operation on a 120-volt, 60-cycle, 2-wire line to dimmer. Ballasts and dimmers are available for rapid start or standard 40-watt T-12 lamps. Dimmers can be equipped with Motorlite or Regulite control for remote operation.

Ward Leonard Electric Co., Mt. Vernon, N. Y.

Connector (11)

A new ½-in. flexible steel conduit connector has been introduced. Features are: easy to install; screws inside flexible conduit; smooth interior and rounded throat prevents snagging of fish tape and damage to insulation; steel construction. Literature available.

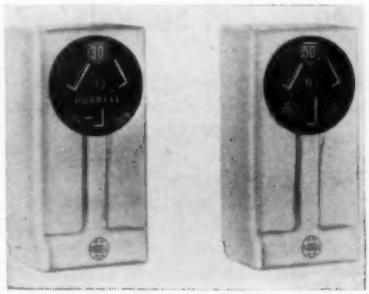
Tomic Sales & Engineering Company, 20000 Sherwood Ave., Detroit 34, Mich.



Pump Motor (12)

A new line of totally-enclosed and explosion-proof, close-coupled pump motors, designed specifically for use with centrifugal pumps operating in dangerous, damp or dusty locations. They are available in horsepowers ranging from 1½ to 25. Features include a face type registered mounting bracket for accurate shaft alignment and simplified pump mounting, precision ground shaft for pump impeller mounting, and solid flange and brass slinger for liquid deflection. The totally enclosed models are sealed for use in locations where destructible dusts, acid fumes, excessive moisture, or other harmful substances prevail. Larger ratings are double-enclosed and fan ventilated for rapid heat dissipation. Smaller ratings are self-cooled by radiation.

U. S. Electrical Motors Inc., Box 2058, Terminal Annex, Los Angeles 54, Calif.



Outlet (13)

A new surface type power outlet with metal cover, is available in both 30 amp and 50 amp ratings. Both units are finished in "Tumblast" aluminum. Units are designed to meet Underwriters Laboratories requirements for a surface type outlet rugged enough to withstand rough usage in industrial or commercial applications. The 30-amp outlet features the L-shaped slot which prevents interchange with 50-amp units..

Harvey Hubbell, Inc., Bridgeport, Conn.

Drum Switch (14)

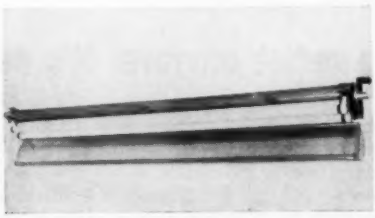
A new Size 1 reversing drum switch is used for across-the-line starting and reversing of ac polyphase or single phase motors, or dc motors. User has a choice of either "maintained contact" or "spring return to off" in same switch. Long wearing nylon shaft bushings; current carrying parts are heavy copper, and contacts are plated. Installation is simplified by a removable slip-on type cover, pressure wire connectors, easy-to-get-at wiring space and accessible mounting holes.

Square D Company, 4041 N. Richards St., Milwaukee 12, Wis.

Conduit (15)

L-M Perma-Line conduit, a bituminized fibre product, is now available in 3½-in. I.D. size, 8 ft long. This size was discontinued in 1946 but is being manufactured again. Manufacture of this size conduit conforms to the requirements of other L-M PermaLine conduit.

Line Material Company, 700 W. Michigan St., Milwaukee 1, Wis.



Fluorescent Luminaire (16)

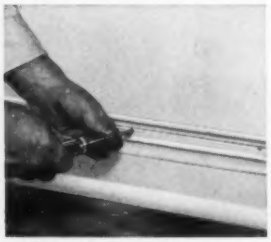
A new fluorescent luminaire for application in tunnels, underpasses, and other locations where low temperatures and low mounting heights are encountered. Units may be mounted between ceiling girders, at junctions of ceiling and side walls, or along center of an arched roof. They can be mounted end to end. Weatherproof and bug proof, the new 2-FU-72 luminaire is intended for use with F100T12/CW/RS or 72-in. T12 slimline lamps. Can be supplied to accommodate either one or two lamps of these types. Multiple ballasts are available for both single and double luminaires to provide several different lamp currents.

Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

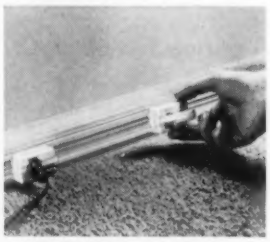
NEW BULLDOG *Electrostrip*

PATENTED

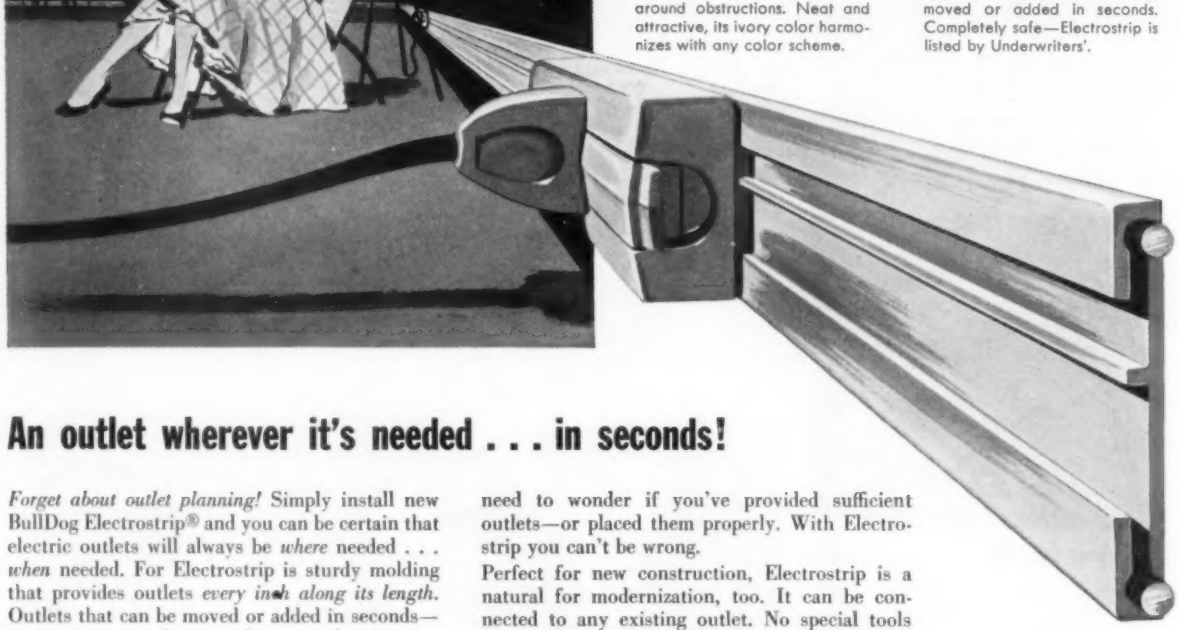
ELIMINATES ELECTRICAL OUTLET PLANNING



EASY TO INSTALL! Electrostrip can be easily and quickly installed on walls, baseboards, floors, anywhere...hand-formed to fit room contour and to bend around obstructions. Neat and attractive, its ivory color harmonizes with any color scheme.



OUTLETS THAT MOVE! Receptacle plugs lock into Electrostrip wherever you want them. Outlets can be placed, and spaced, at any spot on the strip, moved or added in seconds. Completely safe—Electrostrip is listed by Underwriters'.



An outlet wherever it's needed . . . in seconds!

Forget about outlet planning! Simply install new BullDog Electrostrip® and you can be certain that electric outlets will always be *where* needed . . . *when* needed. For Electrostrip is sturdy molding that provides outlets *every inch along its length.* Outlets that can be moved or added in seconds—as requirements change and new needs arise.

Electrostrip mounts neatly on any surface in any home, institution or commercial building. Handy receptacle plugs lock into the strip at any interval . . . exactly where needed. To add more outlets, just add more plugs. It's as simple as that. No need to wonder if you've provided sufficient outlets—or placed them properly. With Electrostrip you can't be wrong.

Perfect for new construction, Electrostrip is a natural for modernization, too. It can be connected to any existing outlet. No special tools required. No need to break into plaster. No wire-fishing or costly replastering. And long, dangerous extension cords become things of the past.

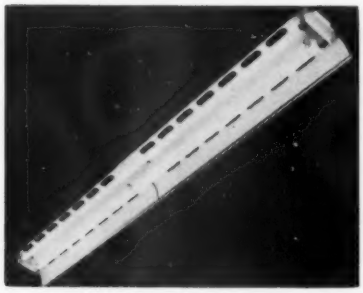
Electrostrip is sold by BullDog distributors only to electrical contractors. See yours. Or write: BullDog Electric Products Co., Detroit 32, Mich.

IF IT'S NEW
. . . IF IT'S DIFFERENT
. . . IF IT'S BETTER . . . IT'S

©BEPCO

BULLDOG
ELECTRIC PRODUCTS COMPANY
A Division of I-T-E Circuit Breaker Company

Export Division: 13 East 40th Street, New York 16, New York. ***In Canada:*** BullDog Electric Products Company (Canada), Ltd., 80 Clayson Road, Toronto 15, Ontario.



Lighting Fixtures (17)

A new "King Size" line of industrial fluorescent fixtures using the recently developed high-output 8-ft rapid-start lamps. All-white slotted-reflector units used with the new fixtures provide an upward component of light to reduce brightness contrasts. For high-bay industrial lighting, the fixtures provide recommended footcandle levels. New 100-watt fluorescent lamps are used in them. Various type reflectors are available. Plunger-type, recessed double-contact lampholders are standard equipment. Contacts are silver plated.

Sylvania Electric Products Inc., 1740 *Broadway, New York* 19, *N. Y.*

Hydraulic Bender (18)

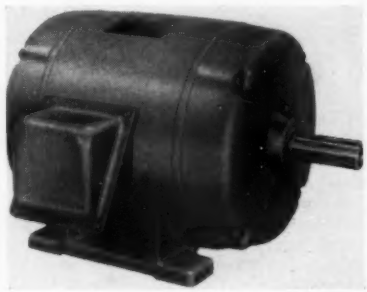
A new lightweight No. 880 hydraulic bender can easily be transported and set up, even in hard-to-get-at locations. Bender consists of two sections, the 2-speed hydraulic pump and bending ram. Linked with a 6-ft section of hi-pressure hose, the two units can be disconnected by a speed coupling for easy handling. Full 90-degree bends can be made with bender with one setting of part to be bent and with one stroke of ram. Although equipped with attachments for bending rigid conduit and pipe from ½-in. to 2-in., the ram is so designed that it will fit other Greenlee bending attachments. Descriptive bulletin is available.

Greenlee Tool Co., Rockford, Ill.

Air Conditioners (19)

A new horizontal line of packaged air conditioners, designed to be suspended from the ceiling or shelf-mounted, includes both water-cooled and air-cooled models. Units are available in 3-, 5-, and 7½-ton capacities. The same hermetically sealed condensing unit used in floor models is used in the new water-cooled units. The entire refrigeration system is replaceable. On air cooled models return air enters through grilles at bottom and sides of unit. On water-cooled models air enters at rear. Side panels snap off for servicing. An automatic electrically-activated "muggy weather control" has been added to give higher moisture removal on humid days. Accessories include a heating coil which can be used with steam or hot water and a 3-way directional air distributor for free air delivery within the conditioned space. The new line supplements the present line of floor models ranging in capacity from 3 to 15 tons.

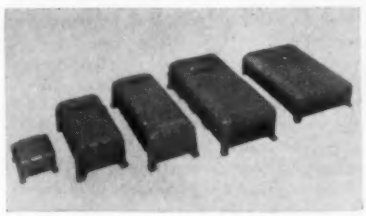
General Electric Co., Bloomfield, N. J.



Motors (20)

A new line of general purpose ball bearing polyphase motors in rerated NEMA frame sizes 182 through 325. Type DP motors with corrosion-resistant cast iron frames are suitable for indoor or outdoor use. Frames are smoothly contoured so that moisture cannot collect on surfaces and construction is dripproof. Ventilating air intakes are located at bottom of end-plates and air outlets are positioned at base of frames on each side. Available in 1 to 30 hp ratings, 3-phase, 60 cycles, 1750 rpm. Bulletin MU-202 is available.

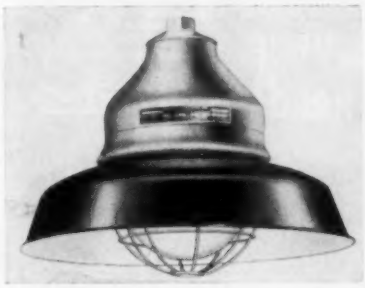
Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis 14, Mo.



Enclosures (21)

A complete, standard line of explosion-proof enclosures for hazardous locations of electrical controls. There are 19 different sizes available, ranging in O.D dimensions from 8¼-in. by 9-in. by 5¼-in. to 14-in. by 24-in. by 9⅜-in. They are machined from aluminum castings to meet NEMA, UL and JIC requirements. Catalog is available.

Gemco Electric Co., 25681 W. Eight Mile Road, Detroit 19, Mich.



Lighting Fixture (22)

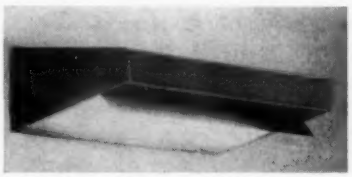
A new type explosion-proof industrial lighting fixture for use in hazardous locations (Class I, Groups C and D). It has mogul screw base porcelain lamp receptacles for 300- or 500-watt lamps. Construction of fixture includes threaded joints except at globe where flange is ground and clamped against a machined surface by means of a threaded ring. Housings are fabricated of cast aluminum alloy, and guards protecting globes of clear impact-resisting glass, are of cadmium plated steel wire. The steel porcelain enameled reflectors are white inside and green outside.

Pyle-National Company, 1344 North Kostner Ave., Chicago 51, Ill.

Tapering Tool (23)

A new self-feeding tapering tool, designated type 504-C, is especially designed for 4-in. Perma-Line conduit. As handle is revolved manually, a threaded feed mechanism guides two tool bits forward automatically to obtain a uniform cut. Tool is portable, weighs 8¾ lbs., and is furnished with a metal carrying case.

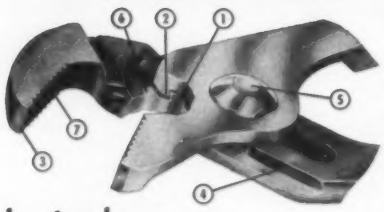
Line Material Company, 700 W. Michigan St., Milwaukee 1, Wis.



Hospital Bed Light (24)

This new hospital bed light provides completely diffused up and down light with trigger start ballasts. Ribbed Plexiglas in both top and bottom directs light to walls and ceiling for room illumination, and across the entire width of the bed for reading, dining, etc. Bed lighting is controlled by a pull switch within easy reach of the patient. Uplight may be controlled by a wall switch, if required. A convenient outlet is provided for use with portable electric appliances. Die-formed and welded of 20 gauge steel, fixture is standard in baked white enamel or aluminum. It is fully enclosed, and for relamping and cleaning, the entire upper diffuser assembly swings into vertical position.

Lightolier, 11 E. 36th St., New York, N. Y.



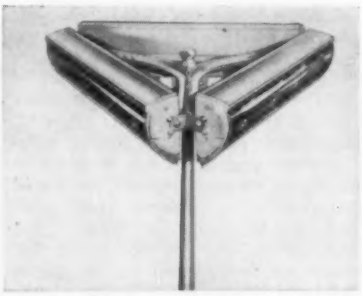
here's why

1. Interlocking principle prevents slipping under any load. **2.** New type wide base lugs cannot shear. **3.** New nose design for gripping small objects. **4.** Patented design of tension edge eliminates stress concentration at channels. **5.** Interlocking design minimizes stress on joint bolt. **6.** Precision machined interlocking surfaces result in perfect fit, distributing pressure evenly. **7.** "Rite Angle" teeth guarantee maximum bite and minimum wear.

Look for the Channellock line when you're shopping for hand tools. Channellock pliers offer features that you can't get with other makes. And when you buy a Channellock plier, ask to see the full line—you'll find a style and model to do any job better.

THE PLIER DESIGN THAT OBSOLETES ALL OTHERS

CHAMPION DeARMENT TOOL CO. • MEADVILLE, PA.



Fluorescent Luminaire (25)

A new fluorescent luminaire, delta-shaped, is designed for parking lots, railroad yards, work areas, or similar applications. It emits an IAS Type V light distribution pattern. Each leg, rated at 245 watts, accommodates two 100-watt, 6-ft, T12 lamps. The main beam output of one leg is about 4240 candle power and has an average unit brightness of three candle power per square inch. Each lamp has individual reflecting surfaces to control the vertical light distribution. One ballast is furnished for each leg of the delta. All metallic parts of units are aluminum, except for non-ferrous fittings. Each cover is translucent plastic which is hinged at top and latched at bottom. Units are weatherproof and bugproof.

Line Material Co., Milwaukee 1, Wis.

Switchboard Meter (26)

A new 250° arc-angle switchboard meter designed to provide extra compactness and ease of reading, while incorporating a new movement. Case design features modern styling to match other panel instruments in this line. Unusually accurate readings are made possible by an exceptionally long scale—2½ times greater than conventional scales.

Roller-Smith Corporation, Bethlehem, Pa.

Lighting Fixtures (27)

A new group of 8- and 16-ft fluorescent lighting fixtures, known as the King Size line, features the recently developed high output rapid-start lamp. Fixtures are specially designed for supermarkets and large drugstores. Available in both single and double lamp units, they are readily adaptable for wall-to-wall lighting systems where high intensity levels are desirable. Units are made of 20 gauge steel channels and provided with grooves running the full length to permit the use of slide grip hangers. End caps are supplied with multiple knock-outs for continuous-row wiring. Flanges with holes permit chain hanging and enable adjacent units to be secured for continuous row installations. Reflectors are available.

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

Reflector (28)

A new aluminum reflector designed for medium and high bay installation. The anodic treated surface will resist discoloring and tarnishing. The slotted neck ventilation induces an updraft, allowing heat generated by lamps to be dissipated in outside air, and airborne dust and dirt to be carried through reflector instead of accumulating on inside surface. When used with 400-watt mercury vapor lamps, units are supplied with neck extension finished in bright red porcelain enamel. For incandescent lamps, 750, 1000, and 1500 watts, units are supplied with neck extension finished in bright green. Color identification is helpful in lighting systems using a combination of mercury and incandescent, especially in twin mounting. Available in socket-reflector, or separable socket styles.

Abolite Lighting Division of Jones Metal Products Co., West Lafayette, Ohio.

Transformer (29)

A new, improved dc current transformer, Type JSU-1, provides for permanent remote indication of large dc currents by isolating the instrument circuit from the dc circuit when making current measurements. It incorporates a window-type design which allows transformer to be slipped over dc bus or cable. It is ideal for applications on electrolytic cells which require large dc currents for the production of aluminum chlorine, magnesium, and zinc. Other applications include use as a feedback source to current balance regulators, dc voltage regulators, motor field and pumpback-current control regulators, and diesel-electric locomotive static excitation controls.

General Electric Company, Schenectady 5, N. Y.

NEW FRACTIONAL H.P. MANUAL STARTER HAS *ALL* THE FEATURES!

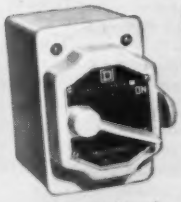
right:
Class 2510
Basic Starter Mechanism

DESIGN LEADERSHIP IN THESE FEATURES:

- ✓ Quick-make, quick-break contact mechanism
- ✓ Single or double pole construction
- ✓ Double break contacts of fine silver
- ✓ Modern styling
- ✓ Straight-through wiring with convenient terminals—generous wire space
- ✓ Dependable melting alloy type overload protection—trip-free
- ✓ Definite trip indication
- ✓ Interchangeable overload relay units accessible from the front
- ✓ Open type starter can be used with standard switch box and flushplate

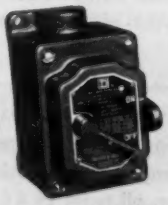
a Variety of Enclosures

General purpose enclosure—with or without pilot light

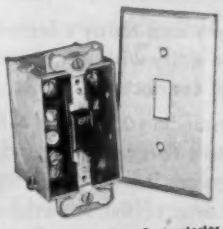


Water-tight and dust-tight enclosure

Water-tight and dust-tight with pilot light



Explosion-resisting enclosure. For hazardous locations—Class I Group D and Class II Groups E, F and G.



Flush mounting. Basic starter mechanism can be used with standard switchbox and flush plate — or with flush plate only for machine tool cavity mounting.

RATINGS

Double pole
1 H.P., 115-230 volts A.C. or D.C.

Single pole
1 H.P., 115-230 volts A.C. and ½ H.P., 115-230 volts D.C.

Write for Bulletin 2510A. Address Square D Company, 4041 N. Richards St., Milwaukee 12, Wisconsin.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

R&S EVER-LOK®

Automatic Locking

RECEPTACLES • PLUGS
CORD
CONNECTORS

#8004 RECEPTACLE
#8014 PLUG

A Complete Line of
Quality Grounding Types to
Meet CODE REQUIREMENTS

2 WIRE, 3 POLE
3 WIRE, 4 POLE

#8733 RECEPTACLE
#8913 PLUG

Meet code requirements and today's increased demand for grounding type units with R&S Ever-Lok plugs, receptacles and cord connectors.

Outstanding advantage of Ever-Lok is an automatic locking feature that grips fast and holds forever. No tug or pull will work it loose- yet it separates instantly with a finger-tip twist of the powerful bayonet type lock. Write for descriptive literature, EL 4 on all types of R&S Ever-Lok.

R&S Ever-Lok complete lines are available from Midget type 10 amperes to 200 amperes heavy service types—standard or reverse service—fused and non-fused types.

MIDGET

10, 20, 30
AMPERES

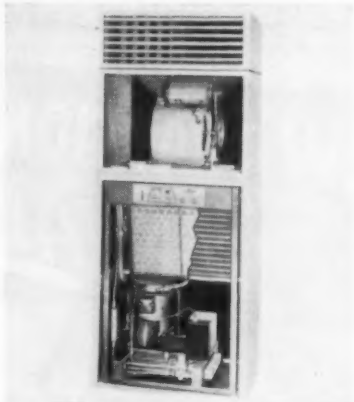
HEAVY
SERVICE

C16

RUSSELL & STOLL COMPANY, INC. • 125 BARCLAY STREET, NEW YORK 7, N.Y.

RUSSELL & STOLL

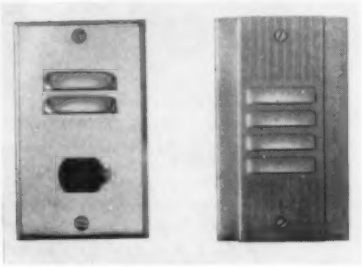
PRECISION-BUILT ELECTRICAL EQUIPMENT—SINCE 1902



Air Conditioners (30)

A new line of eight self-contained store air conditioners consisting of 2-, 3-, 5-, and 7½-ton units both air and water cooled. Units are built in three separate sections—hermetically sealed cooling system; a blower section which can be mounted in a variety of ways; a plenum chamber which provides for front, side, or rear discharge and has a louvered grill with both vertical and horizontal adjustments. Cooling system is mounted in a 'Slide-A-Way" chassis. The line is approved by Underwriters Laboratories.

Mitchell Manufacturing Co., 2525 North Clybourn Ave., Chicago, Ill.



Louvre-Pilot Light (31)

A new line of louvre-pilot combinations, including both 1- and 2-gang combinations, with one combination featuring a Quiette light switch. They are for use in homes, schools, motels, hotels, hospitals, and public and industrial buildings. Brass, ivory, bakelite or stainless steel wall plates are available. Catalog Sheet 28-A is available.

Arrow-Hart & Hegeman Electric Co., Hartford 6, Conn.

Intercom System (32)

Wall-mounted Master stations and "single amplifier" operation are among the features of the new "6000" electronic Intercom System. Master stations are available in cabinets for desk or table, and in wall-mounted housings. Stations may be installed and full communication provided between as many as six Master stations in the new "single conversation" system. In addition to 2-way intercom, the

system provides facilities for paging. The wall-mounted type are available in two models: flush-mount for recessing flush with wall, and surface-mount for installation on existing walls. The central amplifier operates on 110-120 volts, 50-60 cycles ac only.

Executone, Inc., 415 Lexington Ave., New York 17, N. Y.

Instrument (33)

A pocket-size ac clamp volt-ammeter, with a single scale for all ranges and functions, employs a special shock-mounted instrument movement. Known as Model 749, it incorporates the Weston Cormag[r] self-shielded mechanism with spring-backed jewels. Accommodates conductors up to 1-in. round or 1¾-in. by ⅜-in. rectangular. Contains six current ranges of 300/150/60/30/15/6 amps, and three voltage ranges of 600/300/150 volts.

Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

Lighting Unit (34)

A new semi-direct incandescent luminaire, known as Paradome, is for use in classrooms, offices and stores. Unit may be attached to ceiling, or suspended from rods. It is totally enclosed and control of all light rays emitted by either 200- or 300-watt lamps, can be achieved. The design of the bottom concave Controlens has the same effect as tilting a lens away from a viewer. A fiber glass cover fitting snugly on upper dome produces a soft glow on the outer portions of the unit.

Holophane Company, Inc., 342 Madison Ave., New York 17, N. Y.

Fluorescent Fixture (35)

A new series of fluorescent fixtures, known as the "Scott Line", feature a one-piece all plastic shielding. Fixtures are for use in schools, offices and stores. Unit consists of three components—the channel, cover plate, and one-piece shield. Hinging arrangement permits the shield to swing down from either side for maintenance, or it can be removed entirely for cleaning. Fixtures can be surface or pendant mounted and provision is made for continuous row installation. Available in both rapid and instant start.

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

Why
this Jam-Proof 65R
RIDGID
is your fastest selling pipe threader

Easiest to Use... Threads 1", 1¼", 1½" and 2" pipe and conduit with 1 set of chasers that adjust to size in 10 seconds. Mistake-proof self-centering workholder sets instantly to size. Threader can't jam—it kicks out automatically when standard length thread is cut. Unbeatable speed, least work.

Perfect Threads... 65R cuts beautiful threads—the factory test sample is right in each new die stock to prove it. No other threader gives your customers as much for their money.

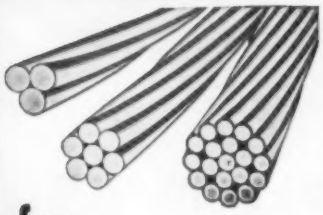
To make money, stock and sell this most popular threader.
Write today for the profit facts on the 65R.

The Ridge Tool Company • Elyria, Ohio, U. S. A.

RIDGID
Work-Saver Pipe Tools

ACCO Quality

PAGE Stainless Steel Strand



for Severe Service Conditions

PAGE Stainless Steel Strand is equally versatile for ground, guy and catenary applications. Its higher tensile strength, corrosion-and-abrasion resistance, elastic limit and strength-to-weight ratio make it your first choice! Its lower cost per year of use means long-range economy.

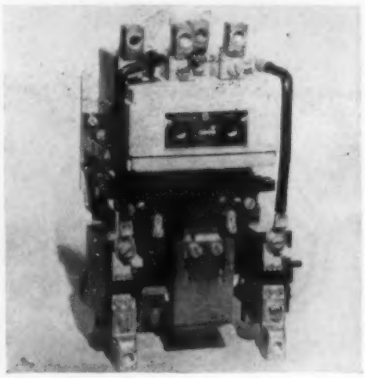
Write us at Monessen, Pa., for complete information

ACCO

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Bridgeport, Conn.

PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

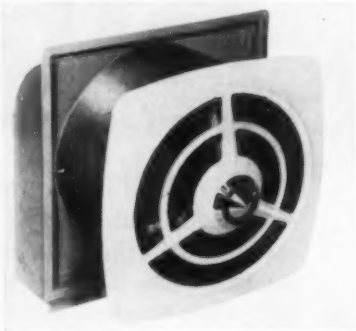
for Better Value



Magnetic Starter (36)

A new NEMA size 4 vertical life magnetic starter designed for motors of up to 100 hp rating. Strongbox coil design includes a cast-on plastic case. A permanent air gap causes starter to drop out when de-energized, and a new type of bimetallic overload relay provides overload protection. Suitable for operation of polyphase motors in ratings of 220 volts, 50 hp, and 440/550 volts—100 hp, starter is available in reversing, multi-speed, and combination forms, and can be obtained with either vertical or horizontal mechanical interlocks.

General Electric Company, Schenectady 5, N.Y.



Ventilating Fans (37)

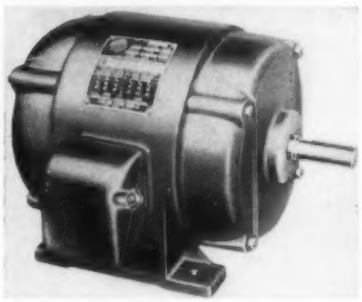
A completely new line of ventilating fans, known as the engineered fan-line. Features are snap-in propeller and motor assembly for easy installation and cleaning, one-piece grille, neoprene grommet mounted to insure vibration-free operation, a weathersealed louver. Available in 8- or 10-in. models in chrome or white enamel grilles. Ten models for wall, thru ceiling, plus combination wall and ceiling fit any fan specifications. Catalog is available.

Victor Ventilator Division, The Philip Carey Mfg. Co., Cincinnati 15, Ohio.

Silicone Rubber Insulation (38)

An all silicone-rubber insulating system for coils of large motors and generators. Called Silco-Flex, the system uses as its basic material Dow-Corning's Silastic silicone rubber. The silicone rubber compound is applied to the coil conductors and vulcanized into a homogeneous mass by application of controlled heat and pressure. The result is a sealed, impervious dielectric barrier, continuous around the coil and leads, which forms a flexible, moisture-resistant wall over entire coil structure. Performance advantages of the new insulation are listed as: heat-, moisture-, and abrasion-resistance; flexibility and resilience; chemical inertness and improved heat dissipation.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.



Motors (39)

A new line of industrial electric motors built to the new NEMA standards. All standard ratings are available in frame sizes 182, 184, 213 and 215. Some of the features of these ac motors include better protection—a lower air opening in the end-bell combined with a steel baffle plate gives maximum protection to the winding from moisture and abrasive dusts in the dripproof design. Double-end ventilation is provided by dual cast aluminum fans. New smaller frame motors provide greater horsepower in a smaller package.

Lima Electric Motor Company, 33 Findlay Road, Lima, Ohio.

Bin-Light (40)

Rectangular bin-light has been specifically designed and constructed for lighting of bins, shelves, stock piles along both sides of narrow aisles. Unit directs diffused light downward to each side of aisle, at angles to illuminate bin interiors from top to bottom tiers. Reflector is porcelain enameled steel, white inside and outside. Available for 75-100-watt and 150-watt lamps, with either pendant, feed through, or outlet box fitting.

Electro-Silv-A-King Corporation, 1535 S. Pauline St., Chicago 8, Ill.

UPTEGRAFF

TYPE UD

OVERHEAD TRANSFORMERS

for power distribution

WINDINGS

Long life is assured by the generous use of high rag-content fullerboard insulation, tied-in turns to meet short circuit forces and heat-reactive insulating varnishes.

CORE

Made from high-grade oriented-type steel. Has low exciting current and low noise level, and remains permanently tight to insure consistent, quiet performance.

TAP CHANGERS

Uptegraff designs feature accessibility, legibility, short-circuit capacity, non-deformable mountings, 360° rotation stops and exceptionally high insulation strength.

BUSHINGS

Securely clamped internally, with generous gasket area to prevent failure of seals. High-voltage bushings (under 15 KV) have spring-loaded contacts; low-voltage have tinned contacts; both for either copper or aluminum conductors.

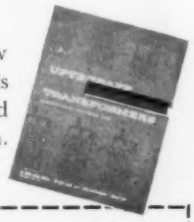
TANKS

All parts are welded. Shot blasting assures adhesion of primer and finish coats of durable transformer paint. Rolled flange on cover permits high-pressure uniform gasket seal.

SIZES AND RATINGS

Type UD Transformers are built in sizes from 3 KVA to 100 KVA with ratings up to 15 KV.

Write for free copy of new bulletin that details characteristics and other pertinent data.



R. E. UPTEGRAFF MANUFACTURING CO.

Scottdale, Pennsylvania

R. E. Uptegraff Manufacturing Co.
Scottdale, Pa.

NAME_____

ADDRESS_____

CITY_____ STATE_____

ECM

G.E.'s 7 quality extras at no extra cost:

(1) Straight-in wiring for quick connections

(2) Slide-out interiors—plenty of working room

(3) Plenty of knockouts, properly located, easily removed

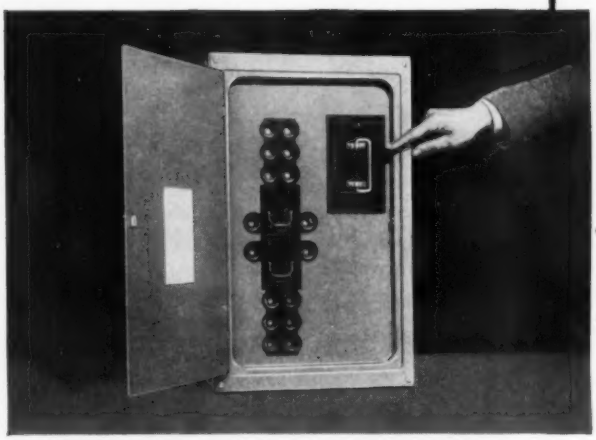
(4) Silver-plated copper current carrying parts for cool operation

(5) Snap-action fuse puller prevents partial contact

(6) Narrow, shallow box construction simplifies flush installations

(7) Bonderite* finish to resist corrosion

*Parker Rust Proof Company



100 amp series fuse puller combination, with 60 amp range and 30 amp branch fuse pullers; 12 or 16 plug fuse branches, Catalog Number TC 3217-16. Snap action pullers prevent partial contact. Quick, straight-in wiring—grips like a bear trap.

G.E.'s new fuse puller line features slide-out interiors, straight-in wiring and five other quality extras at no extra cost

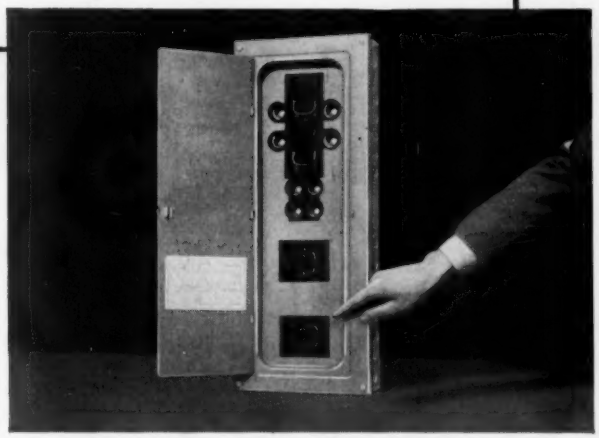
Seven basic fuse puller devices designed to simplify your job from start to finish

Here are 7 new G.E. fuse pullers—built with G.E.'s 7 quality extras for easier installations and better workmanship. Designs include parallel or series wiring and sealable pullers for independently metered equipment. U/L listed. Surface or flush mounted designs.

Check this list, tear out the ad, and see your G.E. Trumbull distributor:

- ☐ **60 amp series main fuse puller only; up to 8 plug fuse branches.**
- ☐ **60 amp series main and range fuse pullers (60 amp each); up to 8 plug fuse branches.**
- ☐ **60 amp series main and range fuse pullers (60 amp each); one 30 amp independent sealable fuse puller; up to 8 plug fuse branches.**
- ☐ **100 amp series main fuse puller, 60 amp range fuse puller and extra 30 amp fuse puller; 12 or 16 plug fuse branches.**
- ☐ **100 amp parallel main and range fuse pullers (60 amp each); up to 8 plug fuse branches.**
- ☐ **100 amp parallel main and range fuse pullers (60 amp each) and one 30 amp independent sealable fuse puller; up to 8 plug fuse branches.**
- ☐ **100 amp parallel main and range fuse pullers (60 amp each), one extra 30 amp fuse puller and one 30 amp independent sealable fuse puller; up to 8 plug fuse branches.**

60 amp series or 100 amp parallel fuse puller combinations, with 60 amp main and range pullers and 30 amp independent sealable puller, Catalog Numbers TC 2214-8 or TC 2219-8. Exclusive slide-out interior gives plenty of working room, requires no screws.



100 amp parallel fuse puller combination, with 60 amp main and range pullers; wired-in branch puller and independent sealable puller are 30 amps each, Catalog Number TC 22119-8. Narrow, shallow box simplifies flush installations.

GENERAL ELECTRIC

NEW! AMERICAN STANDARD
ALUMINUM
STAGES

Made by the makers of the famous Safe-Weight line . . . American Standard Scaffold Planks and Swing Stages provide the most versatile portable decking for every contractor use.

Speed up work and reduce costs. Light weight means labor savings. Durable construction (the patented Louisville Boss rung-to-rail assembly method) makes re-use feasible, economical.

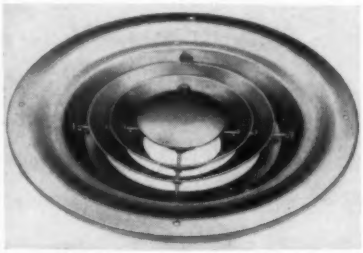
For information as to use on your specific job, and for catalog specification sheets, write or wire:
LOUISVILLE LADDER CO., DEPT. E-2
1101 W. Oak St., Louisville 10, Ky.

LOUISVILLE
ALL TYPES OF ALUMINUM
LADDERS
PLANKS
STAGES

Switchboard (41)

Model 4A30 dial telephone switchboard has been designed for installations requiring 20 to 50 private telephones. Expansion from minimum equipment to a maximum of 8 links and 50 lines is accomplished by plug-in units. Switchboard comes completely equipped, and requires only the addition of telephones to be placed into operation. In addition to normal intercommunications service, many special features available such as paging, speaker phone, code call, and others.

Telecom, Inc., 1019 Admiral Blvd., Kansas City 6, Mo.



Baffle (42)

A new contoured STL baffle is constructed of a series of louvres with an exclusive conical sound diffuser to provide controlled 360° dispersion of even, undistorted low-level sound. It is specifically designed for low ceiling areas such as restaurants, offices, schools, railway cars and wired music installations. They accommodate 6- to 12-in. speakers and mount to a variety of recessed protective speaker enclosures. "Floating conical action" eliminates metallic grommets. Baffles are of 18 gauge spun aluminum.

Lowell Manufacturing Co., 3030 Laclede Station Road, St. Louis 17, Mo.

Wireway (43)

A new line of flangeless wireway equipped with hinged covers which swing open. In addition, the new line also includes auxiliary fittings with hinged covers to make possible the installation of an unbroken wireway system in which conductors can be "laid-in" rather "fished through". Wireways are available in five sizes—2½-in. by 2½-in., 4-in. by 4-in., 4-in. by 6-in., 6-in. by 6-in. and 8-in. by 8-in.—and in standard lengths of 1, 2, 3, 4 and 5 ft.

Keystone Manufacturing Co., 23328 Sherwood, Center Line, Mich.

Receptacle (44)

A new grounding type duplex receptable with parallel slots, which is suitable for use whenever electrical equipment should be grounded as protection for the users. Type No. 5252 can accommodate both grounding and regular type parallel blade caps and is side-wired with a contact break-off for 2-circuit installation. When used with metallic wiring systems, grounding is through metal enclosure. Used with non-metallic wiring systems,

grounding is through a third wire acting as a grounding conductor. Receptacle has a special U-shaped slot for ground blade, and a hexagonal green screw to which the third grounding wire is attached. Both 3-wire and 2-wire grounding type duplex receptacles are available in brown or ivorylite, 15 amps, 125 volts. Catalog Sheet 26-E is available.

Arrow-Hart & Hegeman Electric Co., Hartford 6, Conn.

Post Lantern (45)

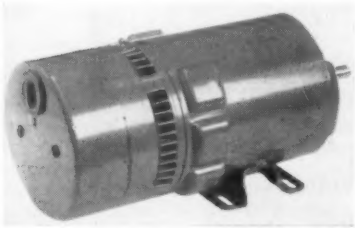
A new Colonial post lantern is made of a new thermoplastic material (clevelon) that resembles wrought iron and never needs painting. Unit is produced in five pieces completely assembled, wired and ready to set in place. The plastic lantern is durable, rustproof, and weatherproof. Post is available in sizes of 9-, 7-, 6-, 4-, 2-, and 1-ft. Lantern size is 33-in. by 16-in. Literature is available.

The Herwig Company, 1757 Sedgwick St., Chicago 14, Ill.

Telephone (46)

A new portable reel-type sound powered telephone for emergency and Civil Defense service. Called the "Communipak", the unit consists of a heavy duty cable reel capable of holding up to 400 ft of rubber-covered telephone cable and is supplied basically with 250 ft of cable installed and two sound powered electric telephone handsets. The voice itself generates the electricity required for its transmission. Heavy duty slip-ring connections provide for 2-way conversation even while cable is being unreeled. Bulletin is available.

Wheeler Insulated Wire Company, Waterbury, Conn.



Brake-Motor (47)

A new totally enclosed, fan-cooled, fhp brake-motor designed to operate overhead doors, cut-off mechanisms, small elevators and for other applications where positive stopping or holding of loads in position is desired. The brake has been redesigned to fit G.E.'s new small-size Form G motor. The combined manual release and wear indicator is recessed in brake housing for visual inspection. Magnetic brake is spring-set and solenoid-release. In event of power failure, it automatically sets, giving added protection. They are available in ¼, ⅓, ½ and ¾ hp ratings at 1725 rpm.

General Electric Co., Schenectady 5, N. Y.

HUBBELL
REG. U.S. PAT. OFF.

INVITATION TO NEW BUSINESS

A COMPLETE LINE OF 3-WIRE GROUNDING DEVICES TO MEET CODE REQUIREMENTS

No. 5273-L
Heavy-duty Composition Adapter

Rugged 3-Wire Caps with U-shaped Blade for Grounding

No. 5262
Specification Grade Convenience Outlet

No. 5264
Armored cap with cord grips.

No. 5274
Finger-grip type

No. 5266
Rubber cap with cord grips.

Whenever grounding is a "must," 3-wire grounding caps (see right) are your invitation to new business. As you know, caps of this kind with U-shaped grounding blade are required by N.E.C. and U.L. on many types of portable electrical equipment rated 125 volts or less.

Point is this: Some of your industrial customers are going to be surprised when they receive portable tools and machine tools equipped with this new 3-wire cap. It will present a plug-in problem . . . unless they have the receptacles, adapters, connectors, etc., to accept the new U-shaped grounding blade.

Don't miss this chance to sell them the devices they'll need. Hubbell's complete grounding line meets every requirement, satisfies the top industrial standard for rugged, dependable performance.

Also a complete line of 250-volt rated grounding devices. Literature on request.

No. 5278
Motor Plug Base (male)

No. 5279
Motor Plug Base (female)

No. 5252
Competitive grade convenience outlet for residential applications.

Highest Grade
HEAVY DUTY
WIRING HUBBELL DEVICES

13HH55

FACTORY WAREHOUSE LOCATIONS ASSURE NATIONWIDE STOCK AVAILABILITY

37 South Sangamon Street, Chicago 7, Illinois
103 North Santa Fe Avenue, Los Angeles 13, California
11-15 Park Place, New York 7, New York
542 Natoma Street, San Francisco, California

HARVEY HUBBELL, INC. DEPT. C-1 BRIDGEPORT, CONN.

"Packaged Electric Power"

UNIVERSAL ELECTRIC PLANTS

Simplified, Sized Right

Size and weight are down—output is up with new Universal Electric Plants. For example, this compact 4-cylinder, air-cooled model delivers 10,000 watts—all voltages available.

For permanent installation or portable service, Universal gives you a wider choice of modern models. Here are favorites for all purposes with a full range of emergency-standby electric plants. You name the controls—we can deliver. From manual starting through all types to fully automatic. These plants are built to your needs, controls included.

More sizes—both air-cooled and water-cooled—insure you the correct money-saving model. Capacities up to 25 k.w., AC and DC—1, 2, 4, and 6 cylinders. All are backed up by one of the oldest names in the electric plant industry. We have produced continuously since 1914 . . . have been in the engine business since 1898.

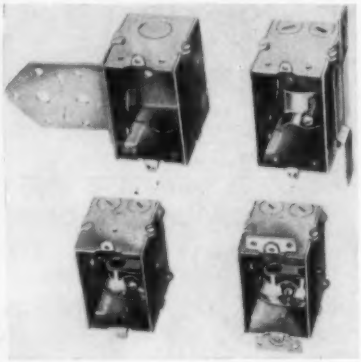
We ask the opportunity to show how we can serve you better

Helpful guide of all Universal air-cooled models plus facts on water-cooled series mailed on request. Write today for this and list showing low Universal prices.

UNIVERSAL MOTOR COMPANY

438 UNIVERSAL DRIVE
OSHKOSH, WISCONSIN

ONE OF AMERICA'S LARGEST, OLDEST BUILDERS OF ELECTRIC PLANTS



Switch Boxes (48)

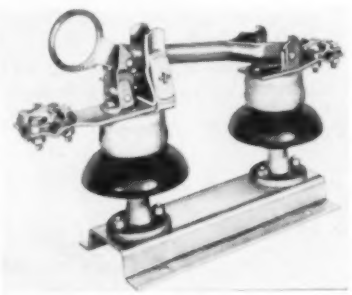
A new line of non-gangable solid switch boxes which incorporate following features; clamps with nested fit; knockouts and "pri-outs" specially designed; one screw adjustment on mounting ears; mounting ears designed to permit maximum adjustment; leveling bumps to assure alignment with studding when box is side mounted; smooth embossed ridges to hold cable. Built to standard dimensions of 1½-in. deep by 2-in. wide by 3-in. long, boxes are available in a variety of styles with clamping; mounting and knock-out arrangements which permit their use on a wide range of applications. Literature is available.

Keystone Manufacturing Co., 23328 Sherwood Road, Center Line, Mich.

Floodlight (49)

A new type explosion-proof floodlight for a wide variety of uses and designed for Class I, Groups C and D hazardous locations. It is designed particularly for use in aircraft maintenance, aircraft refueling operations, as well as for emergency lighting at refineries, distillation plants and plants where industrial dust is a hazard. They are of aluminum lightweight construction and are weather-resistant, light and portable.

Pyle-National Company, 1344 North Kostner Ave., Chicago 51, Ill.



Disconnect Switches (50)

New Type PES and Type PED outdoor, hook-operated, disconnect switches, rated at 400 and 600 amps, 7.5 kv through 69 kv. Type PES is a single-pole, single-throw switch, and PED is a single-pole, double-throw switch. They may be either pole or structure mounted in a vertical or inverted position. An extruded tubular switch blade, having a heavy section of back-up copper, provides extra strength and greater thermal capacity. Adjustable terminal clamps accommodate a wide range of conductor sizes. They meet NEMA specifications.

Line Material Company, 700 W. Michigan St., Milwaukee 1, Wis.

Air Circuit Breakers (51)

Two completely redesigned low voltage breakers rated 40 to 600 amps, 25,000 aic at 600 volts (LA-25) and 200 to 1600 amps, 50,000 aic at 600 volts (LA-50). Breaker innovation include a dead front construction, bridge-type contacts without flexible leads or pigtails, inductive series trip arrangement in higher ratings, hermetically sealed time delay service for trip mechanism, and individual phase trip indication. Thermal magnetic, dual magnetic and selective trip devices are available for these units. The electrically operated LA-25 breaker has a solenoid operating mechanism. On the LA-50, closing is accomplished with a hydraulic system.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.

Display Lighting (52)

Roto Strip No. 103 is for recessed display lighting. You can install one channel with either 8, 5, 3, or 2 lights to make any length continuous run. The recessed Roto Strip retains all the features of the surface mounted Roto-Strip-built-in rotating sockets that swing 90° in all directions and stay put in any angle. Adjustable mounting angles are furnished with each strip.

Neo-Ray Products, Inc., 315 East 22nd St., New York, N. Y.

Secondary Racks (53)

New aluminum secondary racks, designed for pole mounting, provide more uniform stress distribution. They meet all EEI strength and deflection requirements for steel racks. They are interchangeable with existing racks. The new lightweight one-piece construction racks of permanent mold aluminum alloy incorporate an aluminum thru-rod and cotter pin. Smooth contoured surfaces of projecting legs assure non-abrasion of conductor coverings during stringing operations.

Line Material Company, 700 W. Michigan St., Milwaukee 1, Wis.

Receptacle Cover (54)

A new duplex attachment plug receptacle cover for FS and FD Pylets. Made of cadmium plated ferrous alloy, it is weatherproof and raintight. Oil-resistant rubber gasket is secured in center by a metal plate leaving entire perimeter free to float in recessed groove designed to compensate for any irregularities in cover seating surface. Door hinge spring and tension retaining pin are enclosed.

Pyle-National Company, 1344 North Kostner Ave., Chicago 51, Ill.

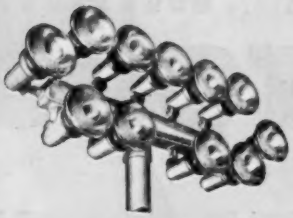
Design that leads the industry plus sound engineering...

As demonstrated by Stonco's new Bell Holder — the unit that literally "air conditions" the lamp to burn cooler and last longer. Advanced shield design offers *full* protection, eliminates back-lighting and affords extra-grip space for quick, easy relamping. These and other features, such as built-in aiming quadrant, adjustable arm-positioning locks and high-temperature "Cushion Seal" protection are only a few reasons why the industry depends on Stonco for better design, backed by "know how" and sound engineering. Write for literature on company letterhead.

Stonco Floodlighting

STONCO ELECTRIC PRODUCTS COMPANY, KENILWORTH, NEW JERSEY

See your Stonco Distributor for —



Cluster Lighting
...a complete line

Super Spots
...a complete line

Vaportight
...a complete line

Plus — a full line of island lights, yard lights and other floodlighting fittings and fixtures.

NOW AVAILABLE

FROM NATION-WIDE WAREHOUSE STOCKS*

BIG CABLES

WITH THE SUPERB

TOUGHNESS

AND

FLEXIBILITY

FOUND ONLY IN

BRONCO

Certified **60**

Bronco 60 Certified Type W cables are made in all sizes from 8/2 to 1/4. They have a tough Neoprene jacket certified by a registered professional engineer to contain not less than 65.46% Neoprene. Made with coarse or fine stranding, Certified Type W possesses incomparable flexibility. The proof is in the product. Try Bronco 60 Certified Type W—you'll standardize with Certified.

Sold nationally only through Electrical Wholesale Distributors and manufactured by

WESTERN INSULATED WIRE CO.
Los Angeles 58, California

Warehouse Stocks Maintained in the Following Cities: ATLANTA, GEORGIA • BALTIMORE, MARYLAND • BOSTON, MASSACHUSETTS • BUFFALO, NEW YORK • CHICAGO, ILLINOIS • DETROIT, MICHIGAN • KANSAS CITY, MISSOURI • LOS ANGELES, CALIFORNIA • LOUISVILLE, KENTUCKY • MINNEAPOLIS, MINNESOTA • NEW YORK, N. Y. • PHILADELPHIA, PENN. • SAN FRANCISCO, CALIFORNIA • SEATTLE, WASHINGTON

Aerial Boom (55)

Design changes have been made in the new Sky-Worker Tree King, providing a higher degree of maneuverability, greater height and longer reach. The lower boom, moving through an overhead arc of 135°, 45° past vertical, results in a material reduction of operating time in reaching areas above, between and behind utility lines. Mounted on a conventional truck chassis, the unit enables a crewman at the controls to place himself at a comfortable working height of 45 ft from the ground. Horizontal working reach from the turret is 32 ft with a working load of 300 pounds. Self-contained auxiliary controls at the base of unit and a molded Fiberglas crow's nest, having no exposed metal parts, are supplied as standard equipment. A completely equipped working "package" is available. It consists of a Tree King, truck, platform body with tool compartment, air compressor, pneumatic pruning tools, cab guard, and compressor guard.

Maxwell Equipment Co., Ford St., Milford, Conn.

Instrument (56)

A new portable Multi-Amp high current test instrument for testing and calibrating overload relays, meters and circuit breakers. It permits trip-time checks on electrical protective devices before installation or while in line. Two models are available, both in a plywood case covered with black pressed fibre and complete with handle and removable hinged cover. Model 1004/44/60 has a timer totalizing 60 minutes in seconds and 1/100's of a minute. Model 1004/44/61 totalizes 60 seconds in 1/100's of a second and 1/4's of a cycle. Bulletin is available.

Multi-Amp Corporation, 10 Third St., Newark 5, N. J.

Distribution Transformers (57)

Design changes have been made in A-C distribution transformers which include improvements in tank and cover shape, gasket principles, bushings, coil supports, tap changers, and terminal boards. The lip of tank is formed into a square-cornered bead. Cover is formed with a high dome and its edge conforms to the shape of the tank lip. The J-bolt assembly provides good corrosion resistance. All high

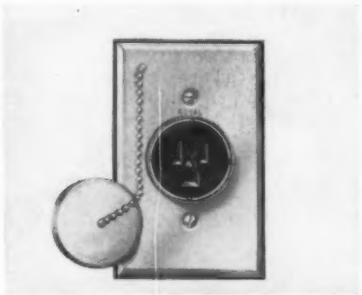
and low voltage bushing terminals are electro-tin plated. Tap changer has a porcelain base. For transformers supplied without taps, the porcelain base is used as a terminal board to which the incoming high voltage line leads and coil leads are clamped by locking wing nuts.

Allis-Chalmers Manufacturing Co. Milwaukee 1, Wis.

Lighting Fixtures (58)

Lantern design incandescent lighting for churches, schools, colleges and public buildings. The fixtures are wired with multiple circuits to permit both high and low levels of glare-free illumination. A wide range of finishes harmonizes with interior decorations. Fine white opal glass cylinders are used. All fixtures are available in various sizes.

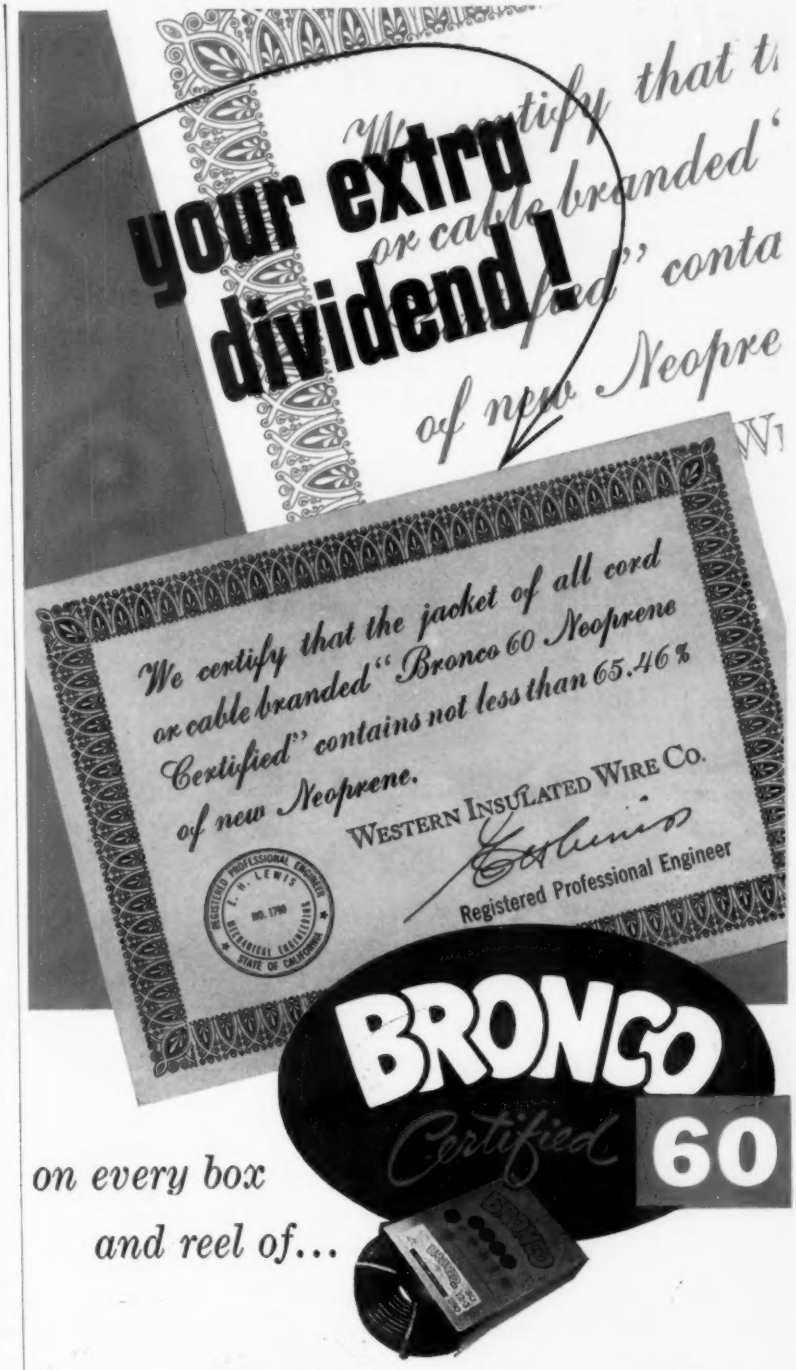
The Novelty Lighting Corp., 2480 *East 22d St., Cleveland* 15, *Ohio.*



Receptacle (59)

A new 3-wire, 15-amp, 125-volt weatherproof receptacle, with a U-shaped grounding slot. It is listed by UL and made especially for the new 3-wire grounding male plugs with round or U-shaped grounding pin, now required on portable tools under present NEMA and UL standards. It will also accommodate all but the largest diameter 2-wire, 15-amp, 125-volt caps; and is suitable for either metallic or non-metallic systems. Mounting plate and screw cover are .040 brass with aluminum finish; complete with weatherproof mat and mounting screws.

Royal Electric Co., Inc., Pawtucket, R. I.


your extra dividend!
We certify that the jacket of all cord or cable branded "Bronco 60 Neoprene Certified" contains not less than 65.46% of new Neoprene.
WESTERN INSULATED WIRE CO.
Registered Professional Engineer
BRONCO
Certified
60
on every box
and reel of...

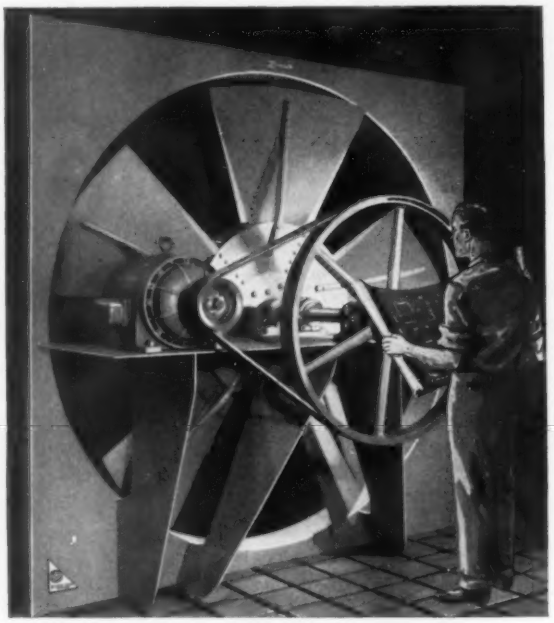
This certification which appears on every box and reel of Bronco 60 Certified portable cable assures you that the protecting jacket contains *a bonus quantity of Neoprene...65.46%!* More Neoprene gives you greater oil-resistance, longer wear, more flexibility. No guesswork. No purchasing by faith alone. You *know* what you are getting. This certificate tells you *exactly* what...and how much. Be sure the wire you buy is *Certified*...and branded.

BRONCO 60 CERTIFIED is sold only through Electrical Wholesale Distributors and is manufactured by

WESTERN INSULATED WIRE CO. • LOS ANGELES 58, CALIFORNIA

WHAT! A PROPELLER FAN
THAT DELIVERS 250,000 cfm!

Yes—they're doing BIG ventilating jobs at propeller fan costs with this wide line of "Buffalo" fans!



- 8" to 120" sizes!
- Easy low-cost installation!
- Shipped completely
- assembled as a "Package".
- All high in efficiency!—for example, this 96" "Buffalo" Propeller Fan at right delivers 80,000 cfm at ¼" s.p. with a 15 h.p. motor!

From the smaller NV-Breezo Fans (8" to 24" sizes) to the Heavy-Duty NV (24" to 96" sizes) and Belt-Air Fans (24" to 144" sizes), there's a fan or combination of fans to ventilate everything from a small room to an entire plant—easily and economically. What's more, this broad "Buffalo" line offers you models for high temperature exhausting, for handling corrosive fumes and for static pressures all the way up to 1". Installation, of course, is simple and fast—just mount these husky, square-paneled packages in square wall openings. And with every "Buffalo" Fan, you get a bonus in quiet, efficient performance for extra years. It's the "Q" Factor*, developed over our 78 years of fan manufacturing. Write for catalogs today and pick the fan you'll always be glad you ordered.

**The "Q" Factor—the built-in quality which provides trouble-free satisfaction and long life.*

"Buffalo"

BUFFALO FORGE COMPANY
520 Broadway Buffalo, N. Y.
PUBLISHERS OF "FAN ENGINEERING" HANDBOOK
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

PROPELLER FANS
BREEZ-AIR ATTIC FANS

BELTED VENT SETS
"L" BREEZO FANS

INDUSTRIAL EXHAUSTERS
"E" BLOWERS

Exit Sign (60)

A new, hinged, surface-type exit sign which is adaptable to a wide variety of building requirements. With interchangeable parts, unit can be converted to either single or double face use, and is mounted from top, back, side or from a pendant. A pivot in door simplifies re-lamping. Two face styles are available: a hinged metal stencil face with 6-in. letters on a fired green or red glass backing, or 6-in. letters on a fired ceramic glass panel, in four color combinations. Approved by Underwriters Laboratories, Inc. and comply with NEC.

Perfeclite Company, 1457 East 40th St., Cleveland, Ohio.

Conduit and Tubing (61)

New polyvinyl chloride-coated rigid conduct and electrical metallic tubing have been announced. The extruded seamless coatings provide uniform, non-porous protection over entire length of raceways, and resist the action of grease and oils, and organic solvents. These coated conduits are especially recommended for installations in areas subjected to unusual atmospheric conditions such as in paper, soap, fertilizer, industrial inorganic and organic product plants, and in canneries, meatpacking and food processing plants. Conduit is available in sizes from ½-in. to 3½-in. and in EMT in sizes from ½-in. to 2-in.

General Electric Company, Bridgeport 2, Conn.

Lamp Annunciators (62)

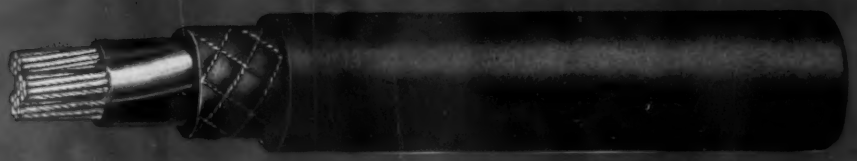
A new design lamp annunciator, known as the GR type, features a wide variety of window sizes—1-in. by 1-in., 1-in. by 2½-in., 2¼-in. by 2¼-in., 2¼-in. by 3½-in. Annunciators employ back-lighted method of illuminating "message" when lamp bulbs light. One or more lamp bulbs can be placed behind engraving and message can be lighted in colors with a steady or flashing signal. Lamp bulbs are easily serviced when hinged door is opened. Relays can be housed in lamp cabinet or may be in separate remotely located cabinet. Either open, anti-dust or hermetically sealed plug-in relays are used.

H. R. Kirkland Co., Morristown, N. J.

CRESCENT

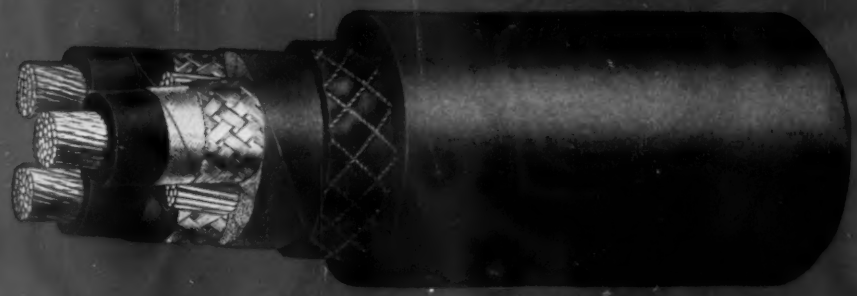
IMPERIAL NEOPRENE

Portable Cables



TYPE W — 600 VOLT CABLE

For use with heavy duty, portable equipment.



TYPE SH-D — 5000 VOLT TRAILING CABLE

For supplying power to electric shovels, dredges, etc.
Shielded to assure protection to personnel and equipment.

CRESCENT

OVER 70 YEARS EXPERIENCE

WIRE & CABLE

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, NEW JERSEY

FIGURE-FACTS from *Ramset* PROFIT ENGINEERS

Ramset PROFIT ENGINEERING SAVES SUBWAY 90% INSTALLATION TIME

Contractor W. P. Pangbourne, by using RAMSET SYSTEM, reduced by 90% the time required to fasten electric conduit in Philadelphia's new 4-mile Market Street subway extension. Worker fatigue also was greatly reduced.

Ramset fastens to concrete and steel—*quicker, easier, better*

Compact, lightweight and free of wires, hose or attachments, the RAMSET JOBMASTER makes easy work of former drudgery-jobs. Optional one-hand operation makes scaffold and ladder work easier, faster, less tiring. Pin-point accuracy of Roto-set Shield and Tru-Set Fasteners produces close-to-perfect alignment with more than ample holding power.

Increase YOUR PROFIT MARGINS with *Ramset* FASTENING SYSTEM

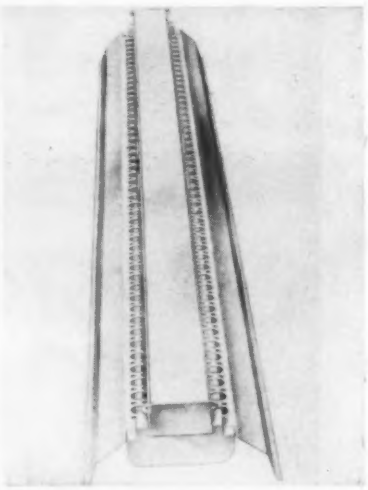
Electric installations of all kinds move along faster with RAMSET SYSTEM. Competitive bids can be lower and profit margins increased. Your nearby RAMSET Dealer will gladly help you "profit engineer" your projects, whether now underway, or in planning stage.

Ask your RAMSET Dealer or write for Application Bulletin E-1, with detailed drawings and specifications for your anchoring work.

Ramset Fasteners, INC.

RAMSET DIVISION • OLIN MATHIESON CHEMICAL CORPORATION

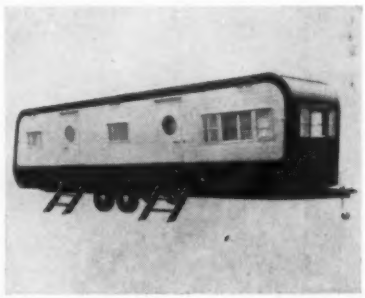
12105 BEREA ROAD • CLEVELAND 11, OHIO



Lighting Unit (63)

A new and improved Turreter "Series 5" unit to provide 10% uplighting by means of apertures in the top of the reflector. Lighting units are available in many variations to meet a wide range of industrial lighting requirements. Units are furnished standard with all white housing. Reflectors, all white inside and out, are available with baked enamel or with porcelain enamel finish. "Series 5" is equipped with Fas-Loc reflector fastener. Units are also available with solid-top reflectors for 100% downlighting.

Smithcraft Lighting Division, Chelsea 50, Mass.



Office Trailer (64)

A newly-designed line of field office trailers and custom mobile units are now available for on-the-job office space. Available with many interior layouts, these compact trailers afford all of the essential facilities of office space. They contain desks, files, closets and drafting tables; are wired for four 48-in. fluorescent lamps and six duplex plug receptacles; contain separate 110-volt circuits for lights and outlets, with necessary circuit protection; include 12 opening windows with screens and venetian blinds. Units are available in lengths ranging from 28 ft to 35 ft Optional furnishings include; partition, toilet, overhead cabinets.

International Trailer Co., Inc., Baltimore, Md.

Product Briefs

(65) Potter & Rayfield, Atlanta, Ga., has announced a new "1500" **coil spreader.**

(66) Boltaron LC 9100, a new low-cost corrugated **luminous ceiling material,** is now available from Bolta Products, Lawrence, Mass. . . . (67) Rae Motor Corp., Racine, Wis., has developed the G-8 **gear reducer,** which can be adapted to its various motors. . . . (68) Two new polyester-molded outdoor current **transformers,** Types EMR and EMO, are available from Westinghouse Electric Corp., Pittsburgh, Pa. . . . (69) To conform with various operating practices of utilities in dead ending aluminum service drop wires, the Jasper Blackburn Corp., St. Louis, Mo., now offers their aluminum service **wedge clamp** with four types of bails.

(70) A new line of easy-to-wire flush range and dryer **receptacles** is now being marketed by Eagle Electric Mfg. Co., Inc., Long Island, N. Y. . . . (71) Westinghouse Electric Corporation, Pittsburgh, Pa., has announced a new 5-kv silicone-insulated current **transformer** designed for indoor metering and relaying applications. . . . (72) A new line of high-voltage, multipart, pin type **insulators,** in the EEI-NEMA class 56-1 through 56-5, is being distributed by the Line Material Co., Milwaukee, Wis. . . . (73) The new magnetic motor controller **relay** Series 210-UM, being produced by the Guardian Electric Manufacturing Co., Chicago, Ill., carries full Underwriters' Laboratories approval.

(74) A new 400 cycle cold cathode **transformer** has been developed by the Cold Cathode Lighting Corp., Long Island City, N. Y. . . . (75) Mall Tool Co., Chicago, Ill., has announced a new Model 3WA portable **generator,** which is a 3000-watt, single-phase, 120-volt ac, 25-amp set. . . . (76) Hendrix Wire & Cable Corp., Boston, Mass., has announced that its new 5 kv Tri-3 aerial **cable clamp** is now available as a separate item for use on secondary distribution circuits. . . . (77) A new **fixture,** designated by Ortho-88 Industrial, is mounted on a Uni-Race channel, sections of which are furnished as part of the fixture, has been developed by Gibson Manufacturing Co., Atlanta, Ga.

(78) Fifteen standard sizes of NEMA 12 sheet metal panel **enclosures** have been introduced by Hoffman Engineering Corporation, Anoke, Minn. . . . (79) Protection against rain, snow, moisture, and excess humidity, is assured with the use of the new weatherproof **switches** and **receptacles** now being marketed by Eagle Electric Mfg. Co., Inc., Long Island City, N. Y. . . . (80) A new, flush-mounted 2-hp **room air conditioner** window unit has been developed by Mitchell Manufacturing Co., Chicago, Ill. . . . (81) A new line of small engine-driven electric **generating plants** ranging in size from 500 to

Porcelain Products' service mast KIT

Everything furnished

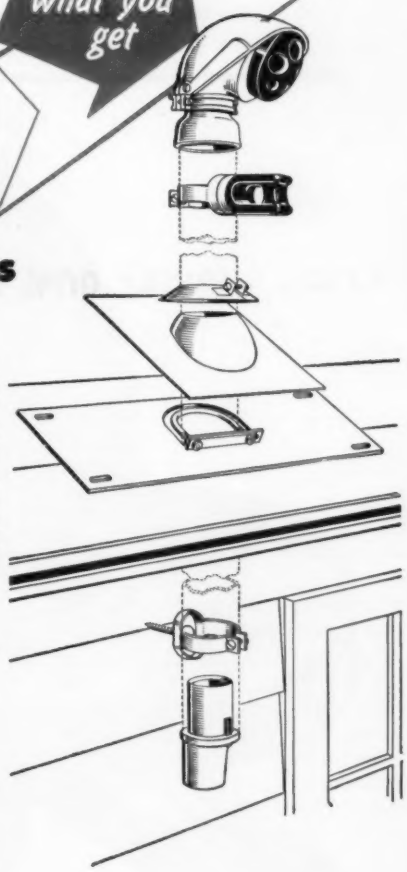
but the house and conduit

2076 SERVICE MAST KIT

Here's what you get

for

Ranch type homes



Available Now!—a Service Entrance Mast kit complete to every detail—including roof flashing. Even necessary bolts, nuts, lag screws, and nails. These articles make up the new Porcelain Products' service mast kit that you'll put up and forget. All components of the kit can be *installed by an electrician, with electricians' tools.*

Here is a list of the parts:

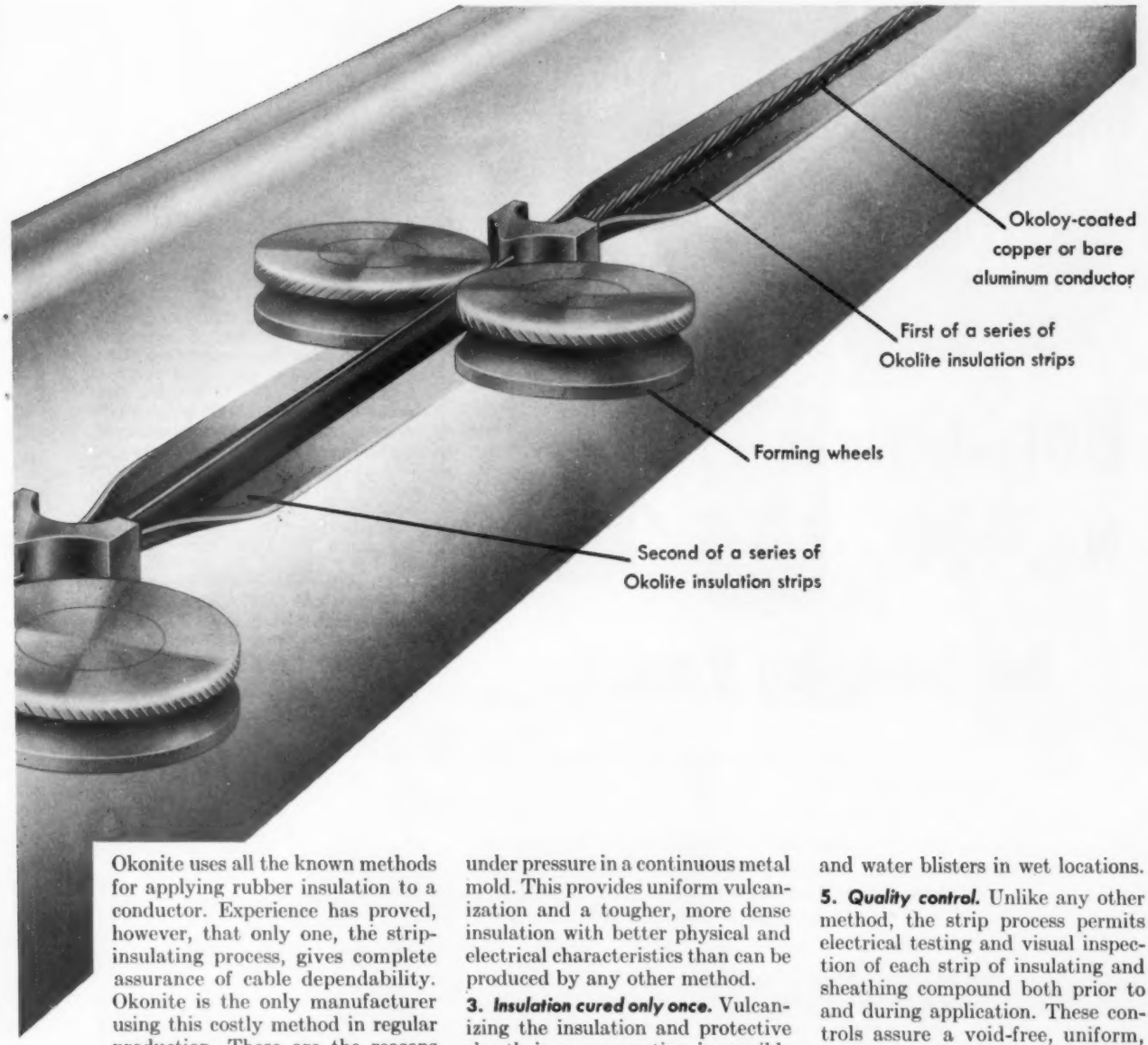
- √ **1¼" UL approved Service Entrance Cap**
- √ **1¼" to 2" Bell Reducer to adapt service cap to conduit**
- √ **Galvanized Roof Flashing and Storm Collar**
- √ **Roof Mounting Plate of new and original design**
- √ **Conduit hanger with 2¼" lag screw attached**
- √ **Slip-fitting offset reducer with interior grounding device**
- √ **All necessary bolts, nuts, lag screws and nails**
- √ ***Plus*—Porcelain Products famous 2061-C Pipe Mounting house brackets as specified.**

Write for details today!

61 years **Porcelain Products, Inc.** PP INC.

FINDLAY, OHIO

Why the strip-insulating process assures longer cable life...



Okonite uses all the known methods for applying rubber insulation to a conductor. Experience has proved, however, that only one, the strip-insulating process, gives complete assurance of cable dependability. Okonite is the only manufacturer using this costly method in regular production. These are the reasons why all Okolite-Okoprene cables are made by this method:

1. *Perfectly centered conductors.* The strip process is the only insulating method that assures perfect centering of the conductor. This assures an insulating wall of uniform thickness along the entire cable length. There are no "thin spots" which might cause premature failure.

2. *More uniform vulcanization.* Okolite-Okoprene cables are vulcanized under pressure in a continuous metal mold. This provides uniform vulcanization and a tougher, more dense insulation with better physical and electrical characteristics than can be produced by any other method.

3. *Insulation cured only once.* Vulcanizing the insulation and protective sheath in one operation is possible only through the use of the strip method. Thus the evil of multiple vulcanization — shorter insulation life — is avoided.

4. *Strong bond between insulation and sheath.* Single, simultaneous vulcanization of the insulation and sheath together in a metal mold under pressure results in a permanent bond between them. This prevents "push backs" during installation, ionization at potentials above 2000 volts, and water blisters in wet locations.

5. *Quality control.* Unlike any other method, the strip process permits electrical testing and visual inspection of each strip of insulating and sheathing compound both prior to and during application. These controls assure a void-free, uniform, solid dielectric wall. Thus, the strip-insulating process has helped Okonite compile its outstanding service records in countless installations. It is also responsible for the continuing high demand for Okolite-Okoprene cables in circuits that *must not fail.*

Write for 128-page manual (Bulletin EC-1085-A) on 0-5kv unshielded Okolite-Okoprene cables and the strip-insulating process to The Okonite Company, Passaic, N. J.

OKONITE OKONITE SINCE 1878 **CABLES**

2891

When You're Ready - It's Ready
It's Homogenized

Borthig
No. 400
Red Insulating Varnish

Here is an insulating varnish that is processed to do every job better.

It gives you unmatched ease of handling because it remains in near-permanent suspension that requires practically no stirring or mixing. It assures a perfect distribution of insulation — plus real economy of use because there is no waste of material through settlement or separation.

In addition, Borthig No. 400 Red Insulating Varnish gives greater acid, alkali, water and oil resistance — uniform and speedy drying — decreased porosity — even color spread — unequaled hiding qualities and stronger adhesion.

And, because Borthig No. 400 Red Insulating Varnish is homogenized, it saves you time. It will not settle in drums or cans, except when left for extreme lengths of time . . . even then it will mix thoroughly with only the slightest agitation.

SOLVED PROBLEMS are another product we deliver

GEORGE C. BORTHIG CO., INC.
Insulating Varnishes
EAST RUTHERFORD 6, NEW JERSEY, Drawer 115

2,500 watts has been announced by D. W. Onan & Sons, Inc., Minneapolis, Minn.

(82) The Watertown Vacumatic Co., Watertown, Conn., has developed a **luminous ceiling panel** for wall-to-wall shadow-free lighting, called the "Wavaco". . . . (83) A new pressure sensitive Vinyl **electrical tape** has been developed by the Bishop Manufacturing Corp., Cedar Grove, N. J. . . . (84) Diamond Expansion Bolt Co., Garwood, N. J., has introduced a complete size range of Diamond carbide tipped core **drills**. . . . (85) A new narrow **pushbutton**, called the "Cameo", designed for chimes, buzzers or bells is being manufactured by the Rodale Manufacturing Co., Inc., Emmaus, Pa.

(86) Pyramid Instrument Corp., Lynbrook, N. J., has announced two new features incorporated in the new **Amprobe Energizer** Model A-40. . . . (87) A new submersible **pump motor**, designed to operate safely while immersed in high-octane gasoline, has been developed by the General Electric Co., Schenectady, N. Y. . . . (88) The Electronic Rectifier Co., Rochester, N. Y., has added the **glass doored science panel** to its line of 128 different, stock rectifiers, battery chargers and transformers. . . . (89) A new cartridge **heating unit**, named Firerod, has been developed by the Watlow Electric Manufacturing Co., St. Louis, Mo.

(90) A new round-chart electronic dynamaster potentiometer **recorder** that can make two continuous records at the same time on a 12-in. round chart, has been announced by the Bristol Co., Waterbury, Conn. . . . (91) A new all grav rubber-jacketed air conditioner **extension cord**, made with UL listed 14-2 type "S" wire, and a molded-on right angle cap and connector, has been announced by the Royal Electric Company, Inc., Pawtucket, R. I. . . . (92) The Bar-Brook Manufacturing Co., Inc., Shreveport, La., has introduced the Model OW-222 **window fan** with 90-degree oscillating louvers. . . . (121) A new fluorescent lighting **fitting**, intended primarily for industrial and commercial use, has been introduced by Metalform Ltd., London, England.

(93) Opad Electric Co., New York 3, N. Y., has introduced a new Type RM5 motor speed **control**, designed to provide stepless, reversible, adjustable speed operation on dc shunt wound motors rated up to 1/15 hp. . . . (94) W. H. Brady Company, Milwaukee, Wis., now has large self-sticking accident prevention **signs** in three standard sizes. . . . (95) Jaws that grip without crushing are on the new No. 1 **pipe vise** announced by the Toledo Pipe Threading Machine Co., Toledo, Ohio. . . . (96) Scrayco, Bound Brook, N. J., has announced explosion-proof level **control** and sealing sphere for extreme temperature operations.

(97) Yardney Electric Corp., New York, N. Y., has developed a rechargeable storage **battery** the size of an ordinary postage stamp. . . . (98) Deltron Incorporated, Glenside, Pa., has introduced a new Model 600A wall mount

"When we decided to Metalclad the 34.5 Kv Primary Gear of our Foundry substation, we saved valuable ground space and had a much better looking installation"

—says Charles Pflug, Plant Engineer at American Motors, Kenosha, Wis.

S&C Metalclad equipment was chosen for this job because it served the purpose so adequately . . . especially with S&C engineering to assure the protection and operating conveniences required.

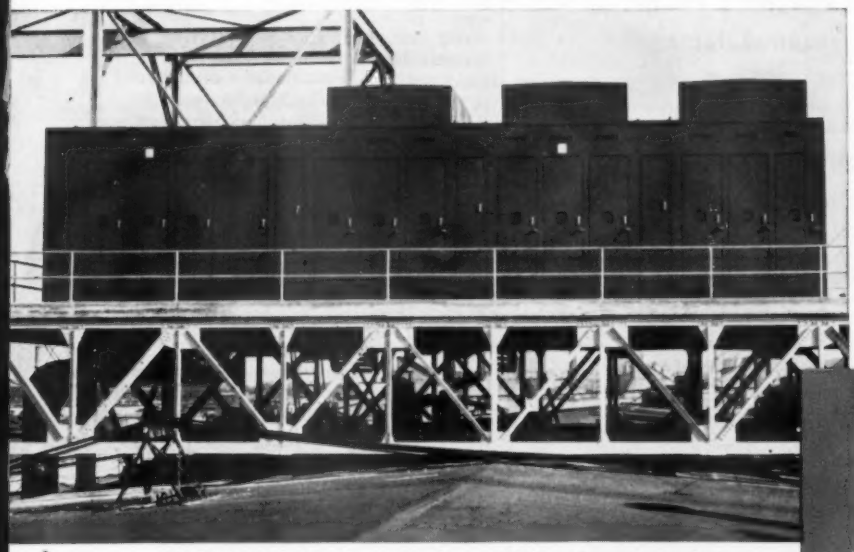
Here it was desirable to control the switching from a point several blocks from the actual installation. Accordingly S&C Load Interrupters were supplied with hydraulic operators to permit remote push-button control.

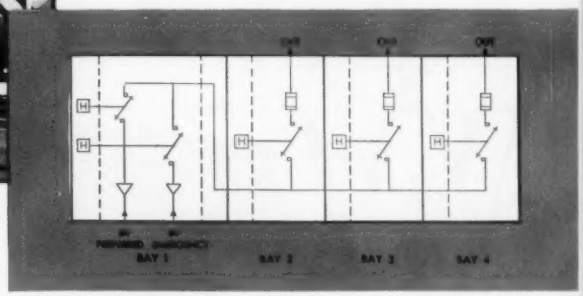
For the sake of appearance as well as protection against lightning and weather, it was preferable to have all the gear enclosed. An even more compelling reason for enclosing the gear was the unavailability of ground space for open structure.

When it was decided that metalclad equipment should be used, mounted above a building roof, it was immediately realized that the unit should be as small and compact as possible to minimize the requirement for supporting structure.

All of these considerations pointed to S&C Metalclad equipment as the logical choice . . . for convenience, for appearance and for protection. This was the judgment of Mr. Charles Pflug, Plant Engineer, and also of the utility engineers with whom he consulted.

S&C was happy to co-operate in designing and building the outstanding installation pictured at left.





S&C Metalclad equipment takes up 50 feet along the roof of one of the American Motors buildings in Kenosha, Wis. Bay 1 contains the two incoming lines providing primary preferred and emergency throwover service at 34.5 kv. Bays 2, 3, and 4 are bus connected to 1200 kva 3-phase transformers.

Specialists in High-Voltage Circuit Interruption since 1910

S&C ELECTRIC COMPANY

4433 RAVENSWOOD AVENUE • CHICAGO 40, ILLINOIS, U. S. A.

In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario

POWER FUSES • DISTRIBUTION CUTOUTS AND FUSE LINKS • LOAD INTERRUPTERS • METALCLAD SWITCHGEAR

WAGNER
FITTINGS
from molten metal to finished fittings
to your customers'
Satisfaction
★ Wagner Malleable Fittings available in a wide variety of types and sizes, are purchased for service dependability. In every case, your customers will get the exact quality required for each application.
Exceptionally well packaged in attractive cartons, these fittings make ideal shelf stock. Each carton is plainly marked for quick identification. It pays well to stock this line.
LOOK FOR THIS MARK STAMPED ON ALL
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WAGNER MALLEABLE PRODUCTS CO.
General Sales Office: 222 W. Adams St., Chicago 6, Ill.
Foundry and Plant: Decatur 60, Ill.

electronic **relay.** . . . (99) A new multifunction **alarm system** has been announced by Industrial Automation Corp., Chicago, Ill. . . . (100) "Fluomatic", a fluid **torque multiplier** for gasoline or electric motors under 10-hp, has been announced by Little Beaver Industries, Willoughby, Ohio.

(101) A new line of general purpose, strip-chart, **recorders** featuring a plastic throw-away inkwell has been introduced by the General Electric Company, Schenectady, N. Y. . . . (102) A line of electrical **switches** for special applications is now available from Industrial Instruments, Inc., Cedar Grove, N. J. . . . (103) The Electric Regulator Corporation, Norwalk, Conn., has developed a new direct-action, finger-type electric circuit control **regulator.** . . . (104) Ilsco Corporation, Cincinnati, Ohio, has developed **shading coils** made from electrolytic copper tubing.

(105) Chase-Shawmut Co., Newburyport, Mass., has announced that all **fuse contacts** are now silver-plated. . . . (106) Hi-heat ceramic **lampholders** are now available in 15 standard models from the Miskella Infra-Red Company, Cleveland, Ohio. . . . (107) Combination time-program and cycle-**controller** has been announced by the Bristol Company, Waterbury, Conn. . . . (108) Lovejoy Flexible Coupling Co., Chicago, Ill., has developed a **variable speed pulley** that provides finger-tip speed changes up to 3 to 1 ratio.

(109) Mystik Adhesive Products, Chicago, Ill., has developed a new Class H pressure-sensitive **tape.** . . . (110) Rockwood Pulley Mfg. Co., Inc., New York, N. Y., has a new auto-tension pivoted **motor base** for use with V-belt or flat belt drives. . . . (111) Mechanical Products, Inc., Jackson, Mich., has announced two new **circuit protectors** for home appliances, Mp-252 (for primary circuit safety) and MP-600 (for protection of secondary circuits).

(112) Hardwick, Hindle, Inc., Newark, N. J., are now in production on five new high-wattage **rheostats.** . . . (113) Bristol Motor Division, Vocaline Company of America, Inc., Old Saybrook, Co., has developed a high torque reversible electric **motor.** . . . (114) A new high-speed, high output, **electric plant** has been announced by Universal Motor Company, Oshkosh, Wis. . . . (115) Pryne and Company, Pomona, Calif., has developed an electric **exhaust fan,** Model 200 with a 10-in. blade.

(116) B. E. Wallace Products Co., Exton, Pa., has announced the new Magic-**Pole A-Frame,** which is a portable "Skyhook" for supporting hoists. . . . (117) Electric Products Division, Georator Corp., Manassas, Va., announces an addition to its line of "No-brush" frequency **converters.** . . . (118) Newest addition to the Ditch-Witch **trencher** line is Model LD featuring a variable speed transmission and completely new design. It is manufactured by the Charles Machine Works, Perry, Okla. . . . (119) Products Engineering & Manufacturing Co., Houston, Texas, is manufacturing a new **tool,** called Race Klamp.

CATALOGS and BULLETINS

(120) Electronic Timers, including delay, repeat cycle, and interval timers are described in a 5-page brochure. G. C. Wilson & Co.

(121) Electrical Tape designated Permacel 2 in 1 is designed for applications which formerly required two separate tapes—heat curing tape for baking and self-sticking tape for insulation and holding. New 4-page folder gives advantages and characteristics of the 14 styles of 2 in 1 tapes. Permacel Tape Corp.

(122) Aluminum-Sheathed Cable for both power and control circuits provides its own flexible conduit. Designed for continuous operation at 150C, this cable is rated at 600v in sizes from 18 to 6 AWG. 8-page bulletin 1088. Okonite Co.

(123) Stud Welding handbook gives specifications, illustrations and dimensions of 12 most commonly used studs; also included is a review of applications and equipment. 16 pages. KSM Products, Inc.

(124) Conductor Systems for traveling cranes and hoists are described in an 8-page bulletin which covers mounting methods, collectors, brackets and a variety of fittings. Philadelphia Tramrail Co.

(125) Electric Trucks for industrial materials-handling. Bulletin SB-3808 covers latest attachments, analysis of unit-load principle, and power requirements; also describes nickel-iron-alkaline storage battery characteristics. Edison Storage Battery Div., Thomas Edison, Inc.

(126) Packaged Dimmers for commercial applications are available in single circuit, 1000-watt units and 2-, 3-, or 4-circuit, 2000-watt units. Up to six controllers may be used in a single bank along with terminal board units. Booklet SE12541, 12 pages, gives circuiting and dimensions as well as operating features. Superior Electric Co.

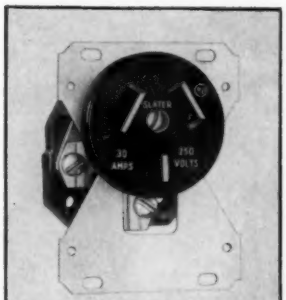
(127) Wiring Devices. New 48-page catalog lists over 600 electrical items used by industry and the home. Rodale Manufacturing Co., Inc.

(128) Motors. Complete buying information on standard ac fractional

SLATER'S NEW
DRYER POWER OUTLET

Designed for continuous lifetime duty, Slater's rugged, new surface-type Power Outlet incorporates many new features that guarantee maximum performance. *Elevator-type terminals* ride up and down with screw. Extra room for fast wiring. Triple knockouts on back and bottom for easy mounting of cable connection. Phosphor-bronze contacts. New NEMA L-shaped slot prevents use of wrong power cap. Available for immediate shipment with black or white phenolic covers. *Order by catalog #388 or 388-W, add G if grounding strap is desired. 50-Amp. Power Outlets for ranges are also available.*

A flush-type power outlet not shown can be mounted on a single gang box. Equipped with clamp-type pressure terminals for faster, more secure connections, this unit is extremely easy to install. It can be back wired. Uses single gang plate in Cadmium or Brass. Rated 30-Amp.-250V. *Order by Catalog #3860.*



Slater's flat strap mounting type Power Outlets have **elevator-type terminals** and the new NEMA L-shaped slot. Ready for wiring, this rugged power outlet, rated 30 amperes-250 volts, is easy to install. Built for lifetime duty. Can be supplied with Cadmium or Brass plates. **Catalog #3840.**

SEND TODAY FOR YOUR FREE COPY OF OUR NEW 4-PAGE FOLDER ON POWER OUTLETS

SLATER
LIFETIME WIRING DEVICES
SLATER ELECTRIC & MFG. CO., INC.

FULLMAN **Latrobe**
Electrical Products

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE PA. SUPREMACY

Floor Boxes and Wiring Specialties

ADJUSTABLE WATERTIGHT FLOOR BOXES

NON-ADJUSTABLE WATERTIGHT FLOOR BOXES

ADJUSTABLE GANG FLOOR BOXES 1-2-3 AND 4

NOZZLES AND FLOOR BOX ACCESSORIES

FLOOR JUNCTION BOXES

UTILITY OUTLETS

INSULATOR SUPPORTS

PIPE AND CONDUIT HANGERS

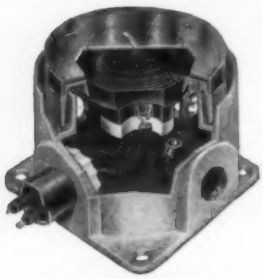
ARMORED CABLE SUPPORTS

CABLE CLIPS

STAPLES

FISH WIRE

Clean and compactly designed to cut installation time to the bone and give smooth, trouble-free service, "Latrobe" Products give a full measure of value.



ADJUSTABLE—WATERTIGHT FLOOR BOXES

Adjustable Floor Boxes are now bonded which makes them fire-proof—come in single round or square bodies—also furnished in square single gang, two gang, three gang and four gang types.

PIPE OR CONDUIT HANGER

Most economical and best pipe hanger sold today. The saddle comes firmly fastened to the hanger bracket and cannot drop out. Made of highest grade malleable iron and has case-hardened, cup point set screw.

Sold only thru wholesalers

Send us your blue-prints or rough sketches for special requirements

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and integral hp motors in general use. Bulletin GEC-1026, 28 pages, gives dimensions, weights, and prices in brief, easy to read manner that aids in selection of proper motor for the job. General Electric Co.

(129) TRANSFORMERS for indoor mercury lighting installations are regulated to deliver constant wattage. Bulletin MV-211 gives in 4 pages a comparison of operating efficiency against non-regulated transformers, and basic electrical and mechanical characteristics. Sola Electric Co.

(130) ACCESSORIES for aluminum conductors are detailed in a comprehensive 12-page manual covering a wide range of connecting, supporting, and reinforcing conditions encountered in use of aluminum wire and cable for overhead transmission and distribution. Reynolds Metals Co.

(131) HEAVY-DUTY CONDUIT called Superduct is basically a Sheradized conduit with an additional baked-on coat of vinyl chloride-acetate copolymer, pigmented and plasticized to resist corrosive atmospheres, heat and cold. Booklet shows comparative tests made on the product. National Electric Products Corp.

132) RESIDENTIAL FANS AND HEATERS are listed in new catalog which covers specifications and dimensions, adapters and extensions for use with various fans, and installation suggestions. Broan Mfg. Co., Inc.

(133) ANCHORING DEVICES. Wall chart lists complete line of expansion bolts and screw anchors, gives hole diameter and depth for each size, also holding strength. Rawlplug Co., Inc.

(134) TYPE H MOTORS. Construction features of the new Uniclosed motors are illustrated in 12-page booklet 1856 which has cut-away drawings that enable complete understanding of important design details. U. S. Electrical Motors Inc.

(135) TRANSFORMERS of the single-phase, oil-filled OISC type are described in 12-page bulletin S-401-B. In addition to shipping weights, dimensions, and NEMA ratings, the booklet gives connecting diagrams, and complete data on accessories. Standard Transformer Co.

(136) GLASS HEATING PANELS, including wall units, portable and baseboard models for residential applications are listed in a 4-page folder that covers dimensions, illustrations, and basic technical data. Infraglass Heater Co., Inc.

Quick Cure

FOR ELECTRONIC *and* ELECTRICAL TROUBLES

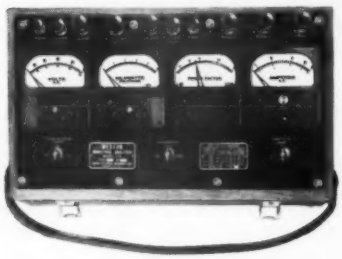
Model 785
Supersensitive
INDUSTRIAL ANALYZER

Model 633
A-C CLAMP VOLT-AMMETER

With these two versatile instruments, the maintenance department is equipped for 'most any trouble that comes along, even on new electronic control equipment.

MODEL 785, for example, has *seven* d-c voltage ranges, 1 to 1000 volts (20,000 ohms per volt)—*six* a-c voltage ranges, 5 to 750 volts (1000 ohms per volt)—*six* d-c current ranges, 50 microamperes to 10 amps.—*four* a-c current ranges, .5 to 10 amperes—*five* resistance ranges, 3000 ohms to 30 megs. All ranges full scale, and current ranges can be extended with external shunts. A complete electrical-electronic maintenance kit.

MODEL 633 is the real time-saver for motorized equipment. Measures a-c voltage and current without breaking the circuit. Has five full-scale a-c current ranges of 1000/250/100/25/10 amperes with range overlap for readability—three self-contained a-c voltage ranges of 700/350/175 volts; with all ranges available through convenient thumb switch, and provision for measuring motor starting current.



Model 639 self-contained POWER ANALYZER

—combines Voltmeter, Wattmeter, Power Factor Meter, Ammeter, *with all interconnections made.*

Both instruments are available through leading distributors. For literature, write Weston Electrical Instrument Corporation, 614 Frelinghuysen Ave., Newark 5, N. J.

WESTON *Instruments*

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

VR's in Automobiles

QUESTION B28—In the voltage regulator used on cars and trucks, what is the difference in construction between one marked positive ground or one marked negative ground?

What instruments are necessary and how are these regulators adjusted?—V.W.B.

ANSWER TO B28—The difference in construction of the positive- and negative-grounded regulators is in the winding on the coils—the shunt coil being the grounded one. Both the shunt and the series coils are wound in the same direction, however. In use, the difference is that one of wrong polarity would cause the contacts to pit and deteriorate and give short life. The application is governed by whether the battery has a positive or a negative ground.

To the second part of the question, the answer is quite involved and a comprehensive answer, I am sure, would take up more space than would be allowed. A voltmeter, ammeter, a fixed resistance and a variable resistance are used. For instance the cutout relay has an air gap, a point-opening and a point-closing check. The voltage regulator has an air gap and voltage setting checks with the latter divided between one of two methods—fixed resistance or variable resistance method. The current regulator has an air gap and a current setting check, which is also divided into one of three methods—jumper lead, battery discharge and load method.

I suggest that you send to the manufacturers of the equipment used and for $1.50 and $2.00 each they will send operation and maintenance manuals which are very easy to understand. Be sure to ask for the test specifications of the units to be tested since they have the specifications for each piece of equipment, starter, generator, etc.—C.S.S.

ANSWER TO B28—The difference in construction between one marked positive-ground and one marked negative-ground is the arrangement of the precious metals forming the contacts. The current flow through the contacts of the positive ground is opposite that of the negative ground, and to avoid pitting it is necessary this current flow in a given direction. Therefore the arrangement of the metal of the contacts is reversed between the two types.

An accurate reading voltmeter and ammeter are necessary for adjustment. Run the motor until the regulator is up to operating temperature then adjust the voltage and current regulators by varying the armature spring tension. The voltmeter is connected from the battery lead to ground, and the ammeter connected in series with generator armature lead. When adjusting the voltage regulator be sure the generator load is less than the current regulator setting to avoid errors in adjustment. The main cutout can be adjusted to close at its proper valve of voltage by adjustment of spring tension also. The adjustments should not be undertaken unless one is somewhat familiar with voltage regulator operation.—W.E.G.

Insulation Tests For Motors

QUESTION C28—When checking motors for moisture, at which megohm reading would it be safe to operate 110-volt motors, 220-volt motors, 440-volt motors and also 2300-volt motors?—E.S.H.

ANSWER TO C28—The old rule-of-the-thumb is one megohm per 1,000 volts with a minimum of one megohm. For 110, 220, and 440-volt motors this would mean a reading of one megohm or better was satisfactory, and a 2300-volt motor would require two megohms or more.

Applied religiously this rule can be extremely expensive. Many a 220-volt motor will operate on 400,000 ohms without trouble, and many a motor megged clear yesterday may ground out today!

By far the best method is to keep a record of periodic Megger readings. For example, if a 440-volt motor has had a 900,000 ohm reading every month for several years, there is no reason to regard the insulation as defective. However, if one month readings suddenly drop to 850,000 ohms, and the next month to 800,000 ohms, an insulation failure impends. Since most insulation failures build up gradually, a system of testing and recording readings on a regular basis will disclose where trouble is brewing in time to permit scheduling maintenance before a failure actually develops.

In the motor shop, one megohm per one thousand volts can be applied effectively to reworked motors, especially since many of the motors have no previous record of Megger tests. No overhauled motor which does not pass the one megohm test should leave the test bench until the trouble is found—D.H.N.

ANSWER TO C28—A safe rule of thumb for rotating machinery is that the insulation resistance should be approximately one megohm for each 1,000 volts of operating voltage, but should not be lower than the minimum value of one megohm. Therefore the Megger reading for the 110, 220, and 440-volt motors should be at least one megohm. A reading of 2.3 megohms or higher would be satisfactory for the 2300-volt motor.

If the motor winding has been damaged physically in any way it would be wise to perform a dielectric test also. To determine the test voltage in this case, double the operating voltage and add 1,000 volts.—J.W.M.

Preloaded Ball Bearings

QUESTION D28—What are preloaded ball bearings and how are they used?—D.H.N.

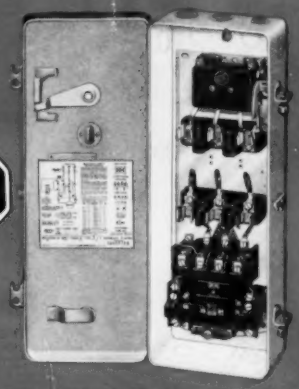
ANSWER TO D28—Briefly the principle of a preloaded bearing is an angular contact ball so arranged that when a load on the bearing increases it also increases the contact of the centering of the bearing. A purely radial ball bearing with an increase in load cannot increase any accuracy of centering. When a bearing is first subjected to a load, a deflection of the bearing takes place. This deflection increases rapidly with the load. This first deflection is taken into consideration by the manufacturer and is calculated in the design of the bearing. Any further loading will be out a slight displacement.

The manufacturer of bearings have at their disposal many precision machines which are used to test bearing since there are many problems encountered in the design of bearings.

Preloaded bearings are manufactured in both single and double row types.

Bulletin 609 Size 0 manual across-the-line starter with START-STOP buttons and two thermal breakers that automatically stop the motor in case of sustained overload. Available in NEMA Type 1 general purpose, NEMA Type 4 waterproof, and NEMA Type 7 explosion-proof enclosures up to 5 hp, 220 v; 7½ hp, 440-550 v.

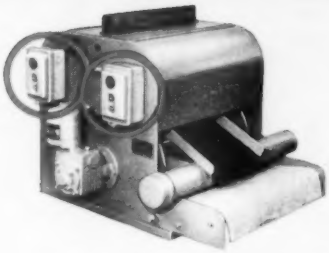
Bulletin 709 Size 3 solenoid across-the-line starter for automatic or remote control. Two thermal relays trip the switch in case of sustained overload. They are available in various NEMA type enclosures up to 300 hp, 220 v; 600 hp, 440-550 v.



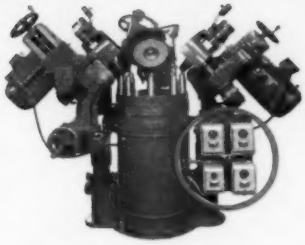
Bulletin 712 combination starter with solenoid starter and manual disconnect in one enclosure. Cover cannot be opened unless disconnect lever is in OFF position.

MANUAL AUTOMATIC COMBINATION

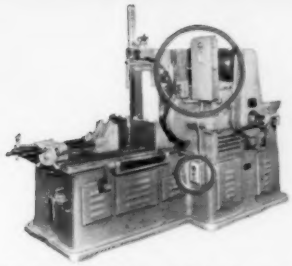
ALLEN-BRADLEY MOTOR STARTERS FOR ALL TYPES OF MACHINES



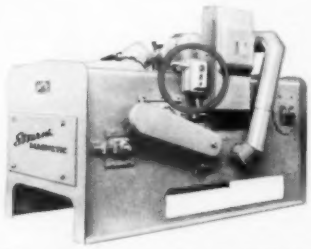
Barnesdril magnetic and fabric filter for removing contaminants from industrial coolants. Equipped with two Bulletin 609 manual starters in general purpose enclosures.



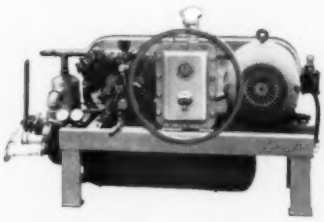
Acme type L-8-L rotary automatic buffing machine for automotive parts. Equipped with four Bulletin 709 solenoid starters with Start and Stop push buttons in starter cover.



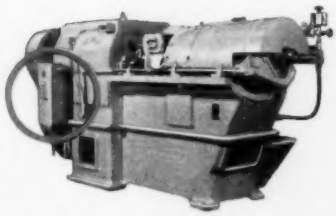
Peerless vertical heavy duty hack saw with Bulletin 712 combination starter for main motor and Bulletin 609 starter for coolant pump. Has oiltight push button station.



Stearns type AM magnetic separator for purifying powdered magnetic materials. Being a dry process, Bulletin 609 manual starter has NEMA Type 1 enclosure.



Loading pump at L.P.G. tank truck terminal equipped with Bulletin 709 solenoid starter in NEMA Type 7 enclosure for safe control in hazardous or explosive atmospheres.



New Britain multiple spindle machine. Equipped with Bulletin 712 combination starter with manual disconnect and solenoid starter in one NEMA Type 1 enclosure.

The preference of machinery builders for Allen-Bradley manual and solenoid starters is world-wide. The A-B trade-mark is recognized, everywhere, as the sign of QUALITY in machine tool control. Send for the Allen-Bradley Handy Catalog . . . a 125-page reference guide on trouble free manual and automatic control. 5-55-M

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ALLEN-BRADLEY
SOLENOID STARTERS
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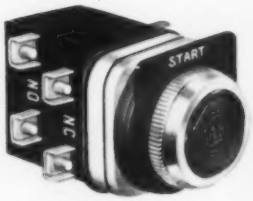
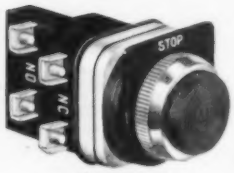
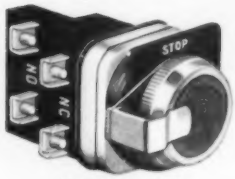


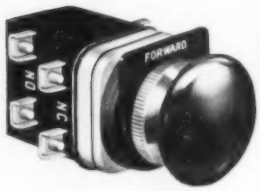
Start button



Stop button



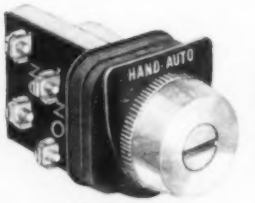
Stop button with locking attachment



Mushroom head button

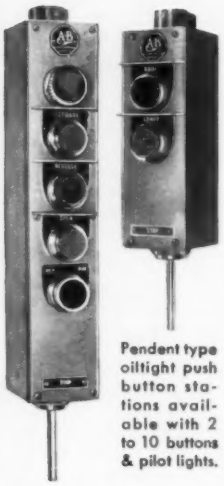
Jog button

Selector switch



Coin slot selector

Open view of 2-button oiltight master station showing method of mounting

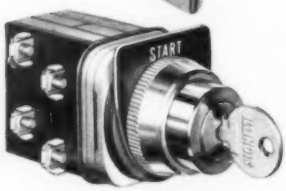


Pendent type oiltight push button stations available with 2 to 10 buttons & pilot lights.

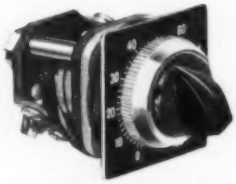
ALLEN-BRADLEY OILTIGHT PUSH BUTTON LINE

that *Satisfies Every Requirement*

Jog button with Start button and Stop & Jog lever



Cylinder lock button



Potentiometer unit

Pilot light Transformer type

Here are a few Allen-Bradley oiltight push button units for machine tools that can be used in endless combinations. All have a flexible, oiltight diaphragm between button and contact block to exclude oil or cutting fluids from contacts. The silver contacts are maintenance free.

Contact blocks may be assembled interchangeably with any type of button. They are available with 1 NO-NC; 2 NO-NC; 4 NO-NC; 2 NO; or 2 NC contacts. Pilot lights of matching design are standard items. See the A-B Handy Catalog for details.

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In Canada—
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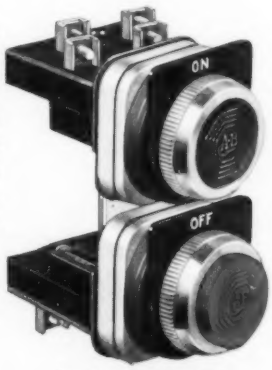

Two-button maintained contact button

5-55-RM

A-B Quality

ALLEN-BRADLEY QUALITY

BULLETIN 800T PUSH BUTTONS

They are used in machines which require accuracy in the work they are to perform. They are also used where shafts and other moving parts are to be centered.—B.A.C.

ANSWER TO D28—Preloaded ball bearings are angular contact ball bearings. They are designed to take a combination of radial and thrust loads, and should be used in pairs unless the load is pure thrust. Preloading consists of placing it under an initial load which is independent of the working load. Preloading tends to reduce the axial deflection under working loads, therefore maintaining accurate alignment of the shaft elements. It behaves like the self-aligning sleeve bearing. —H.S.

Induction Heat In Support Bolts

QUESTION E28—We have a totally enclosed bus duct which has been in service about 18 months. Recently we found that the bolts holding the insulated spacers in place have overheated to the extent that the insulators are badly charred. The only mechanical purpose of these bolts is to hold the insulator in place, not support the bus. Would brass bolts eliminate this or would fibre bolts be better?—H.G.R.

ANSWER TO E28—The details given us are very meager but the use of any material in an enclosed bus duct carrying ac current is a possible source of heating particularly if the current is high and of the order of 1000 amps or more at 60 cycles.

The writer has had trouble where a galvanized clip only one-half way around a fiber conduct carrying a single leg of a 3-phase circuit heated appreciably although the clip was screwed to a wood support and the magnetic circuit was not complete. Local eddy currents even without a complete magnetic circuit will cause this heating. The substitution of brass clips stopped the trouble. For the case under consideration the elimination of any ferrous or magnetic bolts and the substitution of brass or copper bolts will relieve the condition. —C.O.D.

ANSWER TO E28—Your overheated bolts holding your insulating spacers sounds like both induced current and hysteresis loss in the iron or steel bolts. The induced current is the real trouble. Your bus is probably carrying heavy currents which produce very strong magnetic fields. These fields change in polarity and

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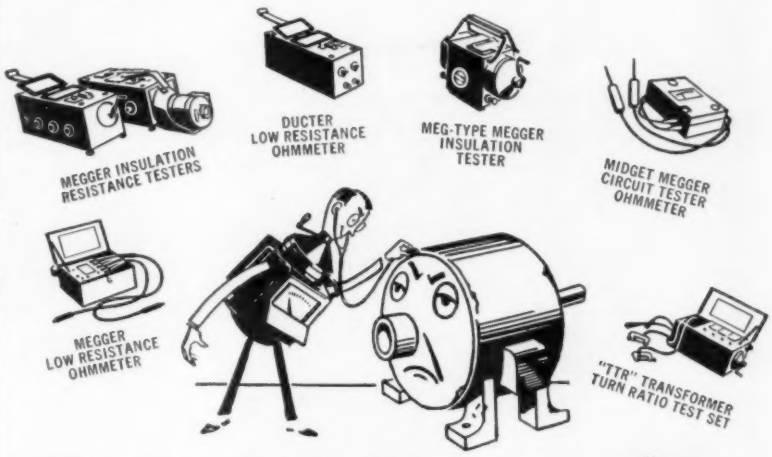
The practice of plant shutdowns for employee vacations is made-to-order for good preventive and *productive* maintenance work on mechanical and electrical equipment. The James G. Biddle Company has devoted years of study and considerable resources to the preparation of educational material to help electrical men practice preventive maintenance.


MEGGER INSULATION RESISTANCE TESTERS
DUCTER LOW RESISTANCE OHMMETER
MEG-TYPE MEGGER INSULATION TESTER
MIDGET MEGGER CIRCUIT TESTER OHMMETER
MEGGER LOW RESISTANCE OHMMETER
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It includes the following bulletins written by practical electrical men for your understanding and guidance. If you don't have File "21" up to date, we invite your request. File 21 will be mailed promptly at no obligation.

- ☐ **Bulletin 21P8**—"The Story of Electrical Insulation Resistance"
- ☐ **Bulletin 21P9**—"Maintenance of Industrial Electrical Equipment"
- ☐ **Bulletin 21P10**—"Cut Electrical Breakdowns"
- ☐ **Bulletin 21P11**—"Getting the Most From Insulation Resistance Measurements"
- ☐ **Bulletin 21P12**—"Preventive Maintenance of Electrical Equipment"
- ☐ **Bulletin 21P16**—"Motor Maintenance with a Check Chart for Alternating- and Direct-Current Motors"

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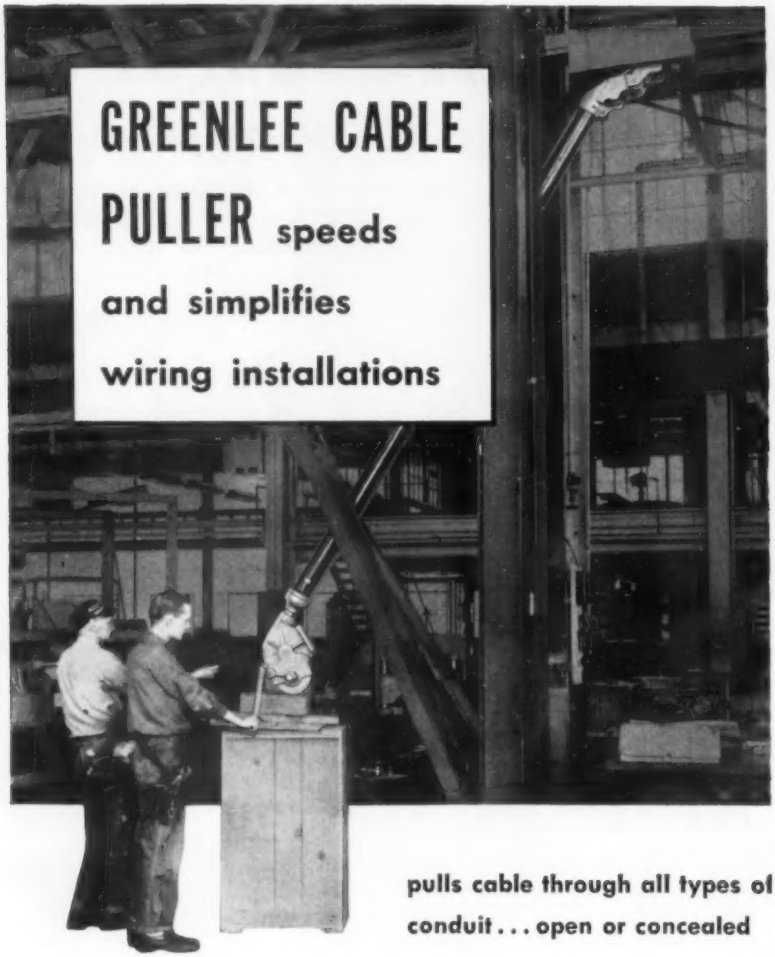

pulls cable through all types of conduit . . . open or concealed

Here's an on-the-job view of a standard GREENLEE Cable Puller with a flexible elbow attachment making simple work of what could have been a mighty tough job.

In about five minutes, three 1,000,000-circular-mil cables were pulled through an 80-foot length of 4-inch conduit which is some 18 feet above the floor level. Setup time included, the entire job took approximately an hour and was handled simply, easily.

Whether you have high overhead jobs like this calling for the use of the attachment, or more routine work, you'll find the GREENLEE Cable Puller a big timesaver that helps get the job done faster, at lower cost. With it you *pull in line with the conduit*. When used without attachments for concealed conduit work, it clamps directly on the conduit. You get a fast, easy pull without straining conduit hangers and eliminate heavy, cumbersome equipment. Use it for open or concealed conduit . . . high up, in close quarters, or out in the open.

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strength with each alternation of the ac. This induces a heavy current in the bolts which causes them to heat. Use copper, brass, or aluminum bolts to replace the steel ones and you won't have the excessive heating.

Article 300 of the National Electrical Code requires one conductor of each phase in a metal raceway or conduit to prevent induced currents from heating the raceway or conduit. When one wire from each phase is in the conduit the magnetic field of each conductor opposes and neutralizes the field from the others, thus preventing excessive induced current in the enclosure.

Your bolts being between the bus are exposed to the field from two of the bus but not from the third bus. The magnetic effects do not neutralize out (as far as the bolts between the bus are concerned) so you have an induced current to heat your bolts.—L.O.W.

Can you ANSWER these QUESTIONS?

QUESTION N28—I recently heard an engineer talking about "third harmonic circulating current" in a 3-phase transformer bank. What is this circulating current, and why can't it be blocked? Does it reduce the capacity of the transformer?—D.H.N.

QUESTION P28—In a public building 100 ft long by 40 ft wide, height 16 ft. what type of electric heating would be the most efficient?—E.S.H.

QUESTION Q28—We have a large plant, which has close to 1,000 machines of various sizes for the purpose of forging and machining 8-in. shells for the army. The power required for the motors on the machines is being supplied by load center transformers, 750 kva, through a 1000-amp, 440-volt bus duct, and there are 23 such units placed throughout the plant.

In the process of installing or removing a duct switch, through an accident the maintenance man creates a ground or a short circuit causing a big splash and burns up the switch, instead of tripping the breaker set for approximately 800 amps, which is only about 25 ft away. It travels down the bus duct 150 ft to the dead end and burns up most of the end section along with whatever switches are plugged near that end.

Will somebody explain what takes place, why does it happen, and is there a solution to overcome such a condition in the future?—S.B.

PLEASE SEND IN YOUR ANSWER BY JULY 15

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Design and Workmanship is second to none in Pylet cast metal conduit fittings. They cover every requirement from service entrance to power outlet in hazardous and non-hazardous locations.

Taper threaded hubs tapped straight and true assure tight joints and perfect alignment of conduit and cover openings.

Cadmium plating of high lustre and thickness provides attractive appearance as well as unexcelled protection against corrosion.

A complete line including circuit control Pylets, plugs and receptacles in all sizes and ratings, industrial lighting fixtures and floodlights.

Specify Pylets for superior performance and long range economy.

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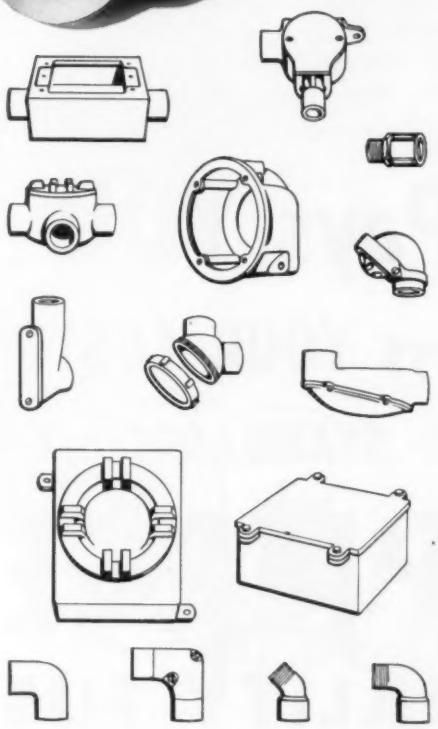

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NEW PLANTS AND EQUIPMENT

[CONTINUED FROM PAGE 95]

Manufacturers now plan to use 47% of their capital spending for expansion, and 53% for modernization in 1955. The greatest shift is reported by textile companies. They devoted only 5% of their capital spending to expansion last year, but plan to raise this share to 23% in 1955. Companies in the transportation equipment, chemical and stone, clay and glass industries also plan marked shifts toward spending a higher percentage for expansion. The only really marked shift in the other direction is planned by petroleum refiners—from 39% for expansion in 1954 to 33% in 1955, amounting to a 15% decrease.

Buildings and Equipment

Manufacturers devoted 27% of their capital expenditures in 1954 to new construction and 73% to the purchase of new equipment. They expect the breakdown to be about the same in 1955—28% for construction and 72% for equipment. (Table V)

Companies in some industries will use a considerably larger proportion of capital spending for new construction this year than last. This is true of the iron and steel, machinery, auto, other transportation equipment and chemical industries. Marked declines in the share spent for construction are expected by paper companies and some of the industries listed under "other metalworking", which includes instruments of various types and fabricated metal products.

The importance of these figures lies not so much in showing year-to-year changes, which are minor in 1954 and 1955, as in the fact that this is new information. These are the first figures for current and future years, based on a large sample of companies, on the distribution of manufacturer's capital expenditures between construction and equipment.

One of the principal reasons given for the previous lack of these statistics is that the distinction between buildings and equipment is extremely difficult to make in some industries, notably chemicals and petroleum refining. In these continuous process industries, a distinction between buildings and equipment is sometimes quite arbitrary, and the figures for these industries should be used cautiously. But, with this caution in mind, the results can be extremely useful to those interested in the present and future level of construction and sales of new equipment.

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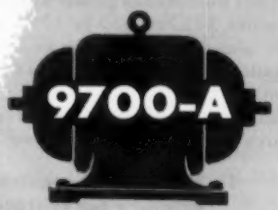
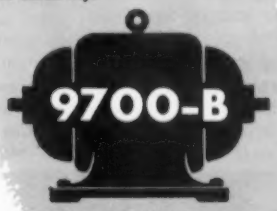
9700—General-purpose grade with overall good through cure, flexibility and durability.



9700-A—Like 9700, but faster set time; tolerates variations in bakes due to heat transfer variances.



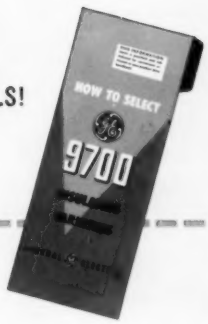
9700-B—Low-viscosity grade for unusually deep penetration plus quick draining without strings.

9700-C—Low-viscosity grade designed to give faster bakes and greater bonding strength.

9700-M — Normal-viscosity grade for faster bakes, greater bonding strength and harder film.

Now you can choose among **FIVE GRADES** in General Electric's versatile 9700 series and expect **"MORE POWER PER POUND"!**

CLIP AND MAIL FOR MORE DETAILS!



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In power plants such as Cutler near Miami, which by midsummer 1955 will have 380,000 kilowatts capacity, and in substations throughout the state CADWELD connections help FP&L speed its gigantic $410,000,000 construction program.

For in fabulous Florida—where industry finds a business climate as favorable as the natural climate—power engineers have found CADWELD connections are best because:

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3—They have greater current carrying capacity—this keeps connections operating cooler than the cable.

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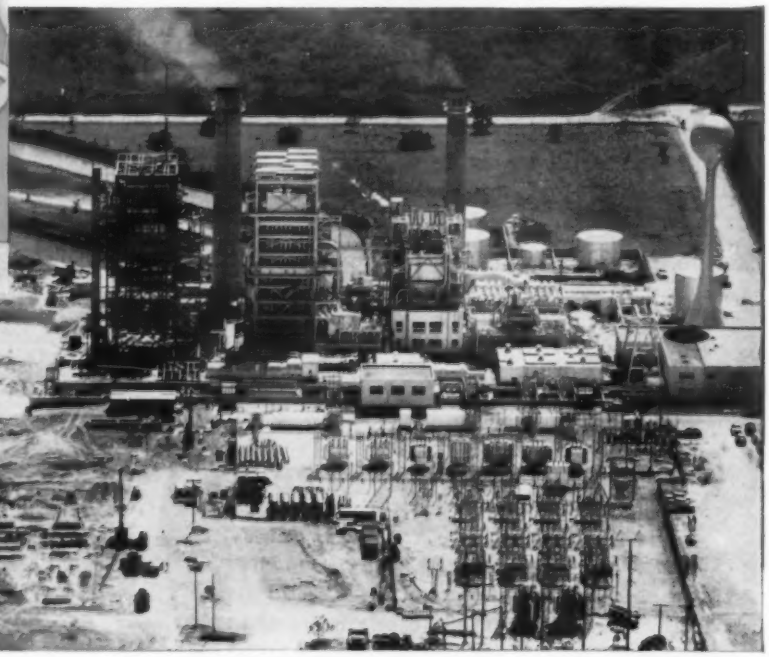
CADWELDED . . . this #2/0 stranded copper cable ground wire to 69 KV steel structure.

Compact, trouble-free CADWELD connections—more than 4500 of them—are used in FP&L's Cutler plant switchyard shown below.



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Questions on the Code

Answered by

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

Grounding on Water Pipes

Q. *The plumbers here at one time or another have tried to have an ordinance put into effect that would prohibit attaching the electrical ground to the water system. Their standard excuse for hot water tank failure is that the electrical ground was the cause. We have coped with this right along, but the problem is back again with a new twist. We have one plumber who is running water services with plastic tubing. The water meters being off the premises forces us to a driven ground, as I see the Code. An ordinance at this time prohibiting this practice is not likely, as we have had quite a to-do concerning pipe failures in the hospital owned by the City, after one year of service. The electrical ground has taken the blame for this condition also. Pointing out the fact that if the electrical service was to blame there would be some damage to the water meter, as the two services enter the building at the same point in the basement and the electrical ground is established immediately, does not change their contention.*

The pipe failure in the hospital was in galvanized pipe installed in the steam returns of autoclaves on the second and third floors. My contention is that galvanic action and also thermocouple currents are to blame, because galvanized pipe was put to this high temperature use. Where or how can I obtain information that will put an end to this misunderstanding on service grounds? Any help in this direction will certainly be appreciated.—I.R.C.

A. The question you have presented, which concerns N.E Code requirements for the grounding of electrical systems and equipment to metallic water pipe electrodes, is one which some 20 years ago was thoroughly investigated by all interested parties. It is a matter of record that the American Water Works Association sanctioned the use of water pipe grounding back in 1920. During the period around 1935 when the Electrical Committee, NFPA, was considering a proposal to further recognize the use of bare neutrals, all factors involved were investigated and debated. In 1945 Mr. Meyerhern, a member of the Article 250 committee on grounding, who represented the American Water Works Association, presented a paper at the annual meeting of the Eastern Section of the International Association of Electrical Inspectors, which fully covers the Water Works Industry's attitude on grounding and stray current problems. I believe a review of same clearly indicates that the AWWA, in a spirit of cooperation and in view of the protection afforded had no objection to grounding systems and equipment to water pipes as required by the Code.

At the present time F. E. Dolson of the St. Louis County Water Company, 6600 Delmar Blvd., University City, St. Louis 3, Mo. is a member of Panel No. 5 which covers Article 250 on grounding. He, I believe, represents the American Water Works Association, and is in a position to either affirm or deny the comment I have made on this subject. I suspect that he also would be interested in the case history of the hospital which has experienced several pipe failures. In view of the thousands of similar installations it is difficult for me to understand how the grounding of the systems and the equipment could cause such failures unless some peculiar conditions are involved or the requirements of the Code are not fully satisfied.

Insofar as the use of plastic tubing is concerned there is a problem which is also shared by other communities. As far as the Code is concerned, we must resort to the use of other electrodes as recognized by Article 250.—B.A.McD.

Conductors

Q. *To feed a 2,000-amp bus, we would like to parallel six 400,000 circular mil conductors for each phase. Would you consider the use of the extra conductor for each phase as a serious Code violation?—M.H.*

A. The use of six conductors paralleled on each phase of a 3-phase service would no longer be a Code violation as Section 3105 of the 1953 Edition of the National Electrical Code no longer limits the number of conductors which may be paralleled on each leg. This limitation of five was found for the last time in the 1951 Edition of the Code. To serve a 2,000-amp bus with 400,000 circular mil conductors would require the use of Type RH insulation and six separate conduits. It is important that not only the conductors be kept exactly the same length for each phase, but that the conduits also be kept the same length in order to assure resistances in each conductor being equal.—G.R.

Coating Conduit Threads

Q. *Is it permissible to use any graphite or coating on conduit threads for a hazardous installation? —E.C.*

A. Article 250, Section 2617 reads as follows: 'If non-conductive protective coating, such as paint or enamel, is used on the equipment, *conduit, couplings* or fittings, such coating shall be removed from threads and other contact surfaces to insure a good electrical connection". This rule under grounding requirements applies to any conduit system installed in any type of occupancy. In hazardous locations it is very important that a good connection is made at couplings and fittings since a poor contact at such points of the conduit system would be a source of arcs and sparks which in the presence of flammable gases, combustible dusts or easily ignitible fibers would present a serious hazard. In order to comply with the above Code rule electricians usually make a standard practice of recutting all factory-cut threads on conduit before installation. Since graphite is a form of carbon and a conductor, it appears that its use as a lubricant would not violate the above rule.—B.A.McD.

Underfloor Raceways

Q. *We are installing some underfloor raceways in a building and find that the right angle turn in*

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these raceways must be made at a point where the occupant will have no need for an outlet. Will the Code require that we place an outlet on top of this 90 degree L even though there is no possible use for such an outlet? —A.B.C.

A. Section 3549 of the Code will definitely require that this outlet be installed. This section reads as follows: "Underfloor raceways shall be laid so that a straight line from the center of one junction box to the center of the next junction box will coincide with the center line of the raceway system." And Section 3550 states: "At every end of line of raceway, a fitting shall be installed extending through the floor to mark the line of the duct. Where a duct line is interrupted by another duct line, but continues in a straight line beyond, and has junction boxes or outlets on either side of the crossing line, no markers are necessary at the interupting point." Therefore, if you did not place an outlet or a marker through the floor at the right angle turn, it would be a direct violation of the National Electrical Code and would also be a serious obstacle to future use of the underfloor raceway.—G.R.

440-Volt Mercury Lamps

Q. *We are planning an all-mercury lighting installation, using 400-watt AHI lamps and 2-lamp ballasts with 440-volt input to the ballast. These will be energized by 3-phase contactors from our plant power bus ducts. The power is 3-phase ungrounded delta.*

The Code says lighting should not operate at more than 300 volts to ground. If we get an accidental ground on our system, the other 2 phases have 440 volts to ground. Mercury lamp ballasts, being auto transformers, place one of our lamp terminals at 440 volts to ground. Thus when an accidental ground occurs we are not within the Code.

Many identical installations using this voltage and hookup are in use in our area, but I did not wish to go ahead with ours if it is considered unsafe or not within the Code.—R.R.

A. You are correct in your analysis of the N. E. Code rules which limit the voltage on a branch circuit supplying ballasts for electric discharge lamps to 300 volts to ground as covered by Section 2113. A 440-volt, 3-phase, ungrounded system has a voltage to ground of 440 volts. This question is covered under Article 100

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CHAMPION *says:*

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GENERAL ELECTRIC *says:*

"The life and light output ratings of fluorescent lamps are based on their use with ballasts providing proper operating characteristics. Ballasts that do not provide proper electrical values may substantially reduce either lamp life or light output, or both. Ballasts certified as built to the specifications adopted by the Certified Ballast Manufacturers (CBM) do provide values that meet or exceed minimum requirements. This certification assures the lamp user, without individual testing, that lamps will operate at values close to their ratings."

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"The light and life ratings of fluorescent lamps are based on three hour burning cycles under specified conditions and with ballasts meeting American Standards Association specifications. Ballasts marked with the CBM emblem and certified by Electrical Testing Laboratories, Inc., meet ASA specifications."

WESTINGHOUSE *says:*

"Use ballasts that are tested and Certified by Electrical Testing Laboratories or ones that are otherwise known to meet the specifications of the lamp manufacturer. These will give best results with Westinghouse fluorescent lamps."

That's why CERTIFIED CBM BALLASTS merit the slogan—Tailored to the Tube.

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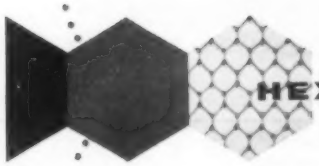

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which covers the definition of "voltage to ground". It reads as follows: "In grounded circuits, the voltage between the given conductor and that point or conductor or a circuit which is grounded; in ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit." It is therefore evident that there would be a Code violation if you were to use your 440-volt delta system to supply the lamps in question. Since the requirements of the Code are considered as basic minimum provisions necessary for safety, any violation of same would be considered as unsafe, and in the event of an accident or death resulting from such a violation, you and possibly your employers would have a difficult time to justify your actions in the eyes of a jury.

Section 2113, exception No. 2, is a new provision in the 1953 Code which extended the use of the 440- or 480-volt, 4-wire wye system with 254 and 277 volts respectively to ground, to additional large sized occupancies. I suspect that some of the installations in your area do have the 4-wire, wye systems, since one of the principal occasions for their development was to limit the voltage to ground at 300 volts or less. If, however, as you undoubtedly know, a delta, 3-wire, 440-volt system is used to supply the ballasts for the lamps in question, there definitely is a Code violation.—B. A. McD.

Oil Burner Installation

Q. *Where in the Code will I find the rule which makes it necessary that a separate circuit be used to serve an oil burner in a house?—A.C.S.*

A. There is no specific rule in the Code which definitely prohibits the extension of an existing circuit to an oil burning furnace with the exception of paragraph a, under Section 2126, which specifies that the total rating of fixed appliances shall not exceed 50% of the branch circuit rating if lighting units or portable appliances are also supplied by either a 15- to 20-amp branch circuit. In many cases if the inspector will add up the various current consuming parts of a hot air furnace or a hot water furnace, he will find the total connected load will often exceed 50% of either a 15- or 20-amp branch circuit. However, on a gravity hot air furnace or on the hot water plant which does not pump the heated water about the building, the total connected load, of course, will not as a rule approach

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50% of even a 15-amp circuit. Many cities do incorporate within their electrical ordinances a requirement for a separate circuit for heating devices. This has been done not so much because of the load as it has been for assurance of reliability and is without question a good engineering practice to follow.—G.R.

What Is a Snap Switch?

Q. *We would like to have your interpretation of what constitutes a snap switch, as referred to in your explanation of panelboard overcurrent protection. Are 15- and 20-amp thermal-magnetic circuit breakers (Westinghouse Quicklag type) considered snap switches? We will appreciate your answer to this question.—W.A.S.*

A. For the benefit of our readers, the rule involved with the above question is Section 3883-b of the N.E. Code, which requires "panelboards equipped with snap switches rated at 30-amp or less shall have overcurrent protection not in excess of 200 amps". This provision was first recognized in the Code as Interim Amendment No. 59 approved August 11, 1942. A short time later Official Interpretation No. 234, was issued on November 30, 1942. It reads as follows:

Question 1: Was it the intent to include other control devices such as circuit breakers, knife switches, plug-in units, and so forth, in the limitation of the interim amendment which reads:

"Snap switches rated at 30-amp or less and employed in panelboards shall have overcurrent protection not in excess of 30 amps?"

Finding: NO.

Question No. 2: What is the N.E. Code definition of the term "Snap switch"?

Finding: There is none, but it was the intent of interim amendment No. 59 that the term should be applied to devices controlling branch circuits, the operation of which could not be manually halted when positive motion had once been imparted to the contact-making or closing member.

This Official Interpretation raised a question as to the need for a Code definition for a "snap switch". The Article 100 Committee on definitions believed that this question should be decided by the Article 380 Committee. This was back in 1945 when the 1946 Code was under consideration. Since that time I know of no other action on this question.

As a result of the above findings, it appears evident that the 15- and 20-amp circuit breakers (Westinghouse

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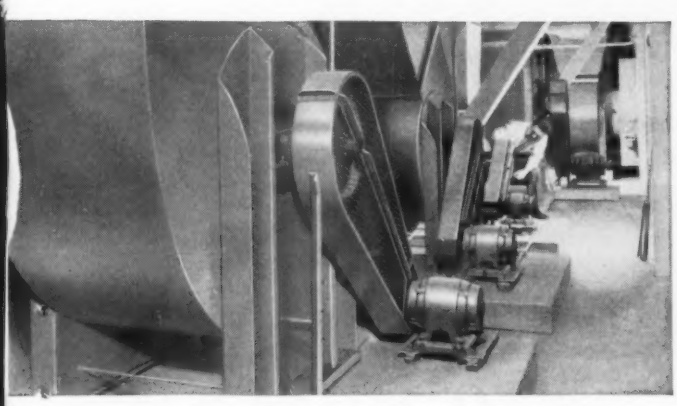

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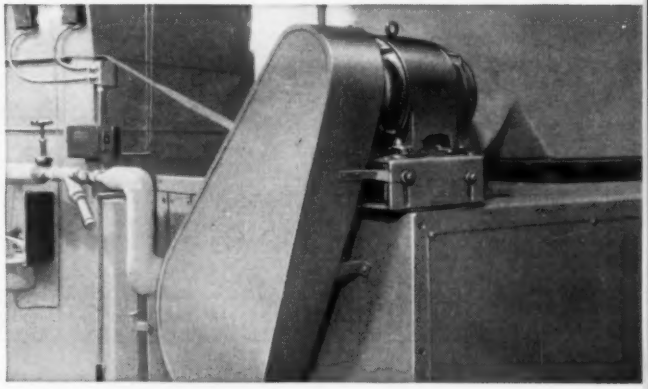

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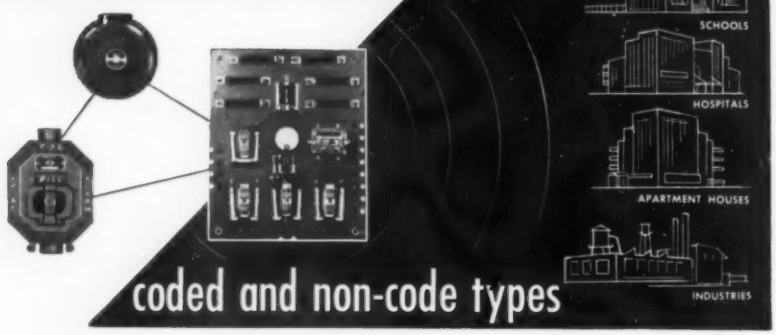
Interior Fire Alarm Systems



coded and non-code types

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Quicklag type) are not considered as snap switches. Insofar as the definition of a snap switch is concerned I believe, in addition to the intent already given, that Abbott's *National Electrical Code Handbook* covers the matter more clearly. It reads as follows:

"The term snap switch as used here and elsewhere in the Code is intended to include, in general, the common types of flush and surface mounted switches used for the control of lighting equipment and small appliances and the switches used to control branch circuits on lighting panelboards. These switches are now usually of the tumbler or toggle type but can be the rotary-snap or pushbutton type. The term is not applied to circuit breakers or to switches of the type that are commonly known as knife switches."—B.A.McD.

Conductors

Q. *Somewhere in the Code there is permission to use a 2-conductor cable having a white and black wire on a switch leg. May the white wire be used between the switch and the outlet, or must it be used between the switch and the source of power?* —P.M.

A. Paragraph b. under Section 2006 gives permission to use a 2-conductor cable containing a black and white wire for single pole switch legs and a 3-conductor cable for 3- or 4-way switch loops. In the fine print note following this permission you will also notice it is unnecessary to paint the terminal end of the identified conductor or the white wire at the switch outlet. Under paragraph b. it provides that the white wire or the identified wire shall be the conductor used between the source of energy and the switch.—G.R.

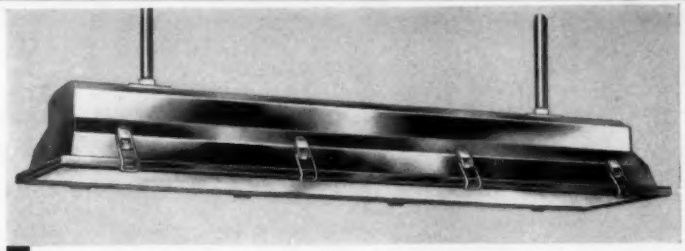
Mineral Insulated Cable

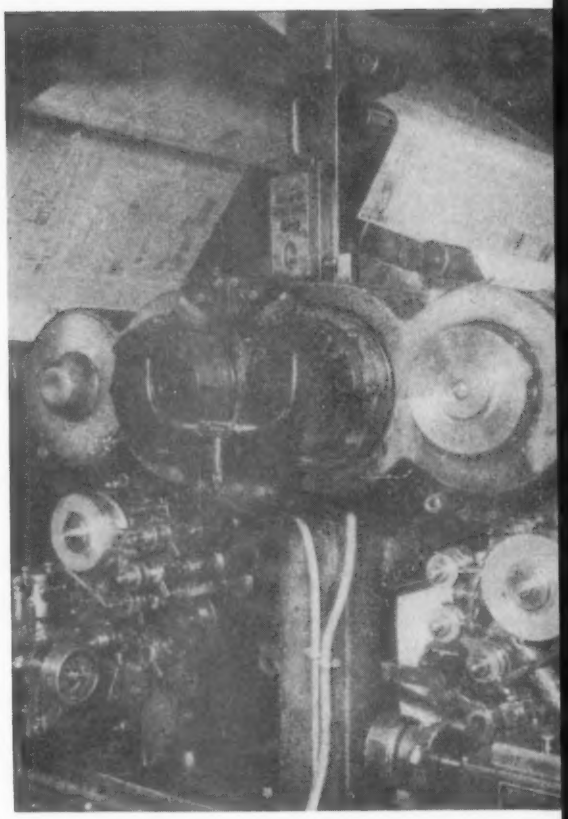
Q. *The new copper clad wire cable using magnesium oxide as the dielectric is very popular here for certain installations since space limitations and moisture or corrosive fumes are prevalent. We require to know if the Code has any special recommendations for the excellent new material. The General Cable Company is the manufacturer. May the cable sheath be legally used as the neutral conductor? When will the newest issue of the Code be available?*—P.C.Z.

A. The cable to which you refer undoubtedly is Mineral Insu-

engineered lighting

for hazardous and specialized locations





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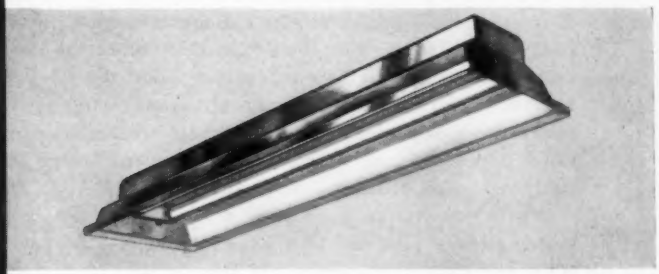

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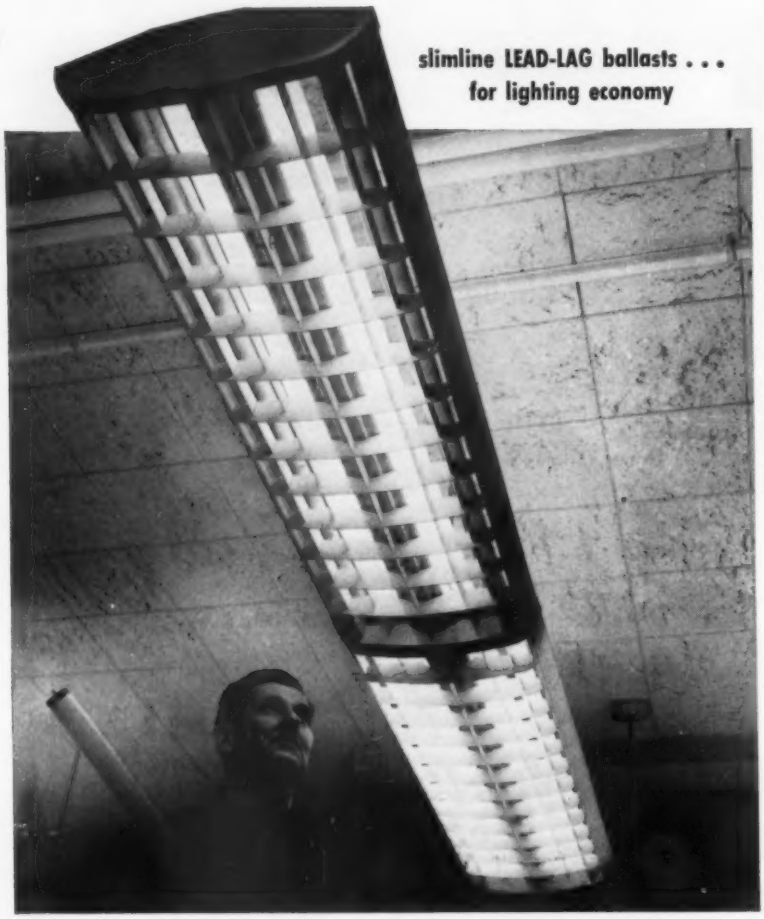

Above fixture equipped with series ballast. Lamp on right has burned out causing left lamp to burn at reduced light output. With LEAD-LAG ballast, left lamp would burn at full output.

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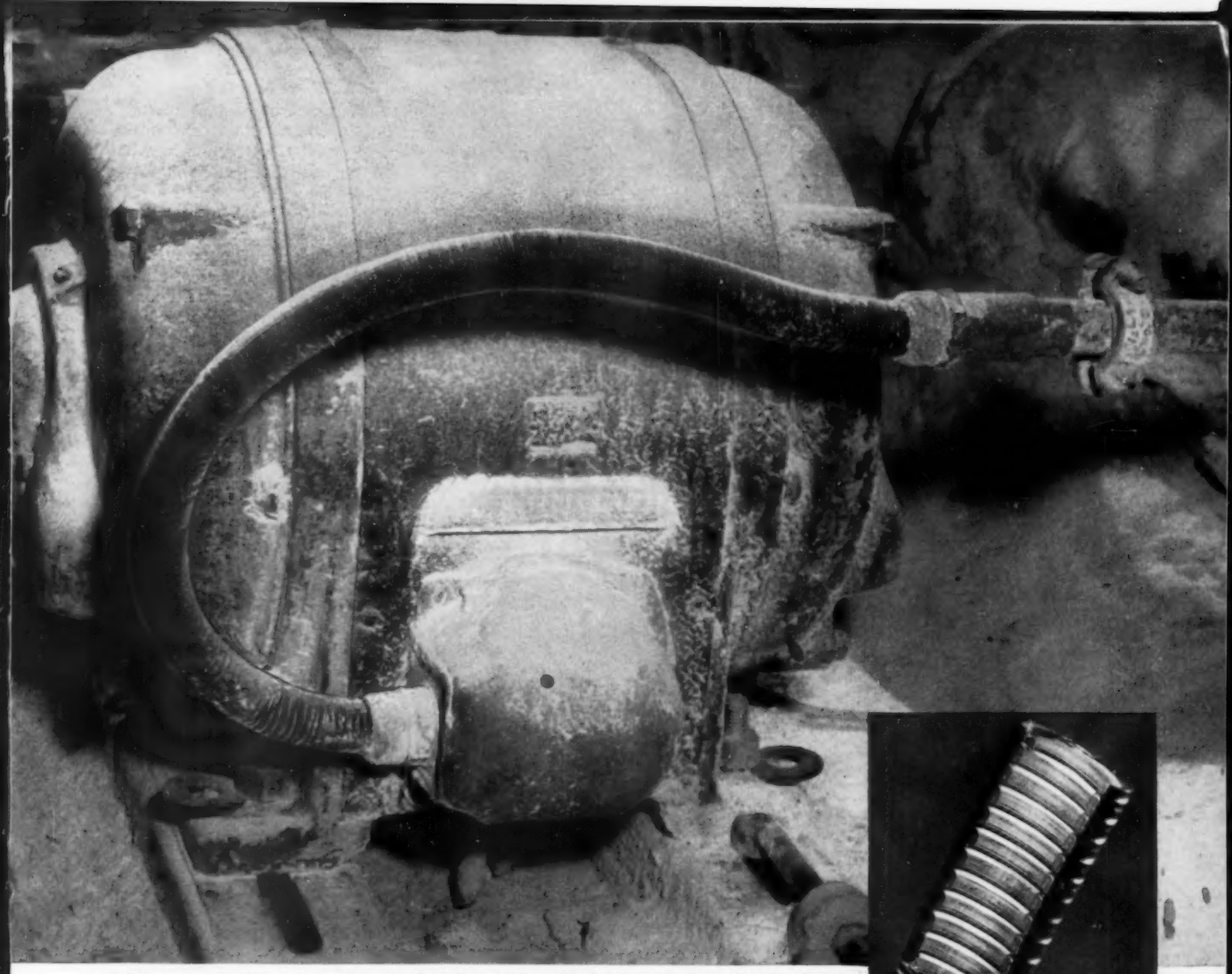
lated Metal Sheathed Cable, Type MI. This cable was first recognized in the 1953 edition of the Code, as one of our wiring methods, under Article 330. While the Code does not have any special recommendations for this wiring method it does recognize it for use in all types of buildings and occupancies except hazardous locations as covered by Article 500. It is quite possible, after current investigations of the cable fittings have been completed, that it will be recognized for some or all of the Classes and Divisions of hazardous locations. Under the Table in Article 310, Section 3102 it is significant to note that this mineral insulation has a maximum operating temperature of 85°C which may be increased to 250°C for special applications. The cable assembly consists of one or more copper conductors insulated with highly compressed magnesium oxide and enclosed in a continuous copper sheath. It is approved by the Underwriters' Laboratories in sizes 16 to 4/0 AWG 1-conductor, 16 to 4 AWG 2- and 3-conductor, 16 to 6 AWG 4-conductor and 16 to 10 AWG 7-conductor with a 600-volt rating.

The cable sheath may not legally or otherwise be used as the neutral conductor. To do so would promote a hazard which could nullify the excellent qualities of this wiring material. According to schedule the next edition of the N. E. Code will appear on the market about October 1956. —B. A. McD.

Wireways in Hoistways

Q. *I have been told by a salesman that I can place a wireway in an elevator shaft, and yet in the Code I notice wireways are not permitted in hoistways by Section 3622. Since I would like to run new feeders in a hoistway or elevator shaft during a rewiring job I have in this plant, I would like very much to be able to use a wireway. As the salesman says this section of the Code never intended to include the restriction covering hoistways, I will be most appreciative to know whether or not he is right.—P.K.*

A. The salesman is correct, as the restriction pertaining to the prohibition of the use of wireways in hoistways has now been deleted from Section 3622 of the 1953 Edition of the National Electrical Code. This actually was printed in error, as it was not the intent of the electrical committee to prohibit the use of a wireway in elevator shafts. However, the first edition of the National Electrical Code



Sealtite protects leads to motor under a blanket of penetrating, chemical "snow"—powdered calcium sulphate, magnesium oxide and magnesium chloride.

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Westvaco saves money with Sealtite. They used to wrap ordinary flexible steel conduit with rubber tape, then give it two coats of a hard, protective varnish. That cost from $3 to $5 per lead. Now they save this money. Sealtite has its own protective covering—a tough, extruded polyvinyl. But more important—since 1950 there haven't been any circuit failures at equipment protected by Sealtite.

What can Sealtite do for you? It resists oil . . . chemicals . . . corrosive atmospheres . . . weather. It absorbs vibration . . . protects wiring between moving parts . . . solves problems of misalignment. For complete information, write: *The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn.*

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Cutaway section of Type UA Sealtite shows tough polyvinyl covering over interlocked, zinc-plated steel strip. Copper conductor wound spirally in space between each convolution inside conduit provides positive ground.

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contained this restriction and shortly after this publication, the electrical committee issued a correction which was given as wide distribution as possible asking that everyone delete item 2 under Section 3622 which prohibited the installation of a wireway in a hoistway elevator shaft or escalator well. If you will refer to Section 6206, you will note there that your edition of the National Electrical Code provides for wireways within hoistways.—G.R.

Sealing Conduits—Aircraft Hangars

Q. *We presently have a contract to install the electrical work in some aircraft hangars. The question arises relative to sealing certain conduits. These conduits are to be installed underneath the concrete floors (16 in.) of the hazardous area, but terminate in non-hazardous areas.*

Will it be necessary to use sealing fittings at the locations where the conduits leave the hazardous areas and enter the non-hazardous areas even though the conduit is continuous and 16 in. beneath the floor in the hazardous area?—E.B.

A. According to Section 5115—G of the N.E. Code "Raceways in or under the floor (of an aircraft hangar) shall be considered to be in a Class 1, Division 1 location." Section 5115-c also says that "all wiring in or under the hangar floors shall conform to the requirements for Class 1, Division 1." Section 5115-G also requires seals to be provided in conformance with Section 5015 of Article 500. In view of these requirements, it appears evident that seals must be provided in each conduit run leaving the Class 1, Division 1 hazardous location as required by Section 5015-A-3. It appears to me that Panel No. 14 of the Electrical Committee in considering the Code provision were of the opinion that any conduit, even though it was buried 16 inches in the ground below the concrete floor, could be exposed to gases or vapors which might find their way into the conduit. Drilling the floor for flanges etc. might be an occasion for leakage through the floor, or gasoline pipes might be run in such areas. It appears however that the requirement for sealing in a commercial garage, covered by Section 5105-d, is not so restrictive. It reads as follows:

"Raceways embedded in a masonry floor or buried beneath a floor (of a commercial garage) shall be considered to be within the hazardous area above the floor if any connections or extensions lead into or through such area."—B.A.McD.

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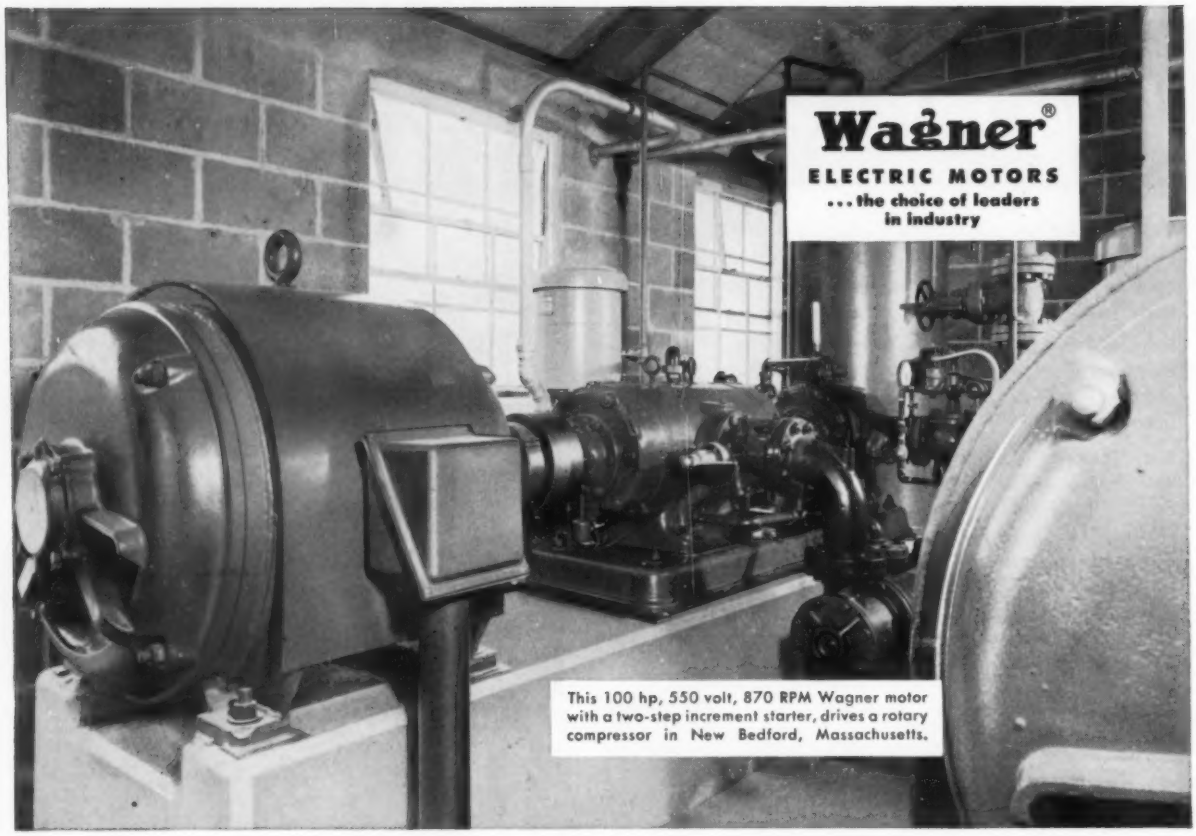

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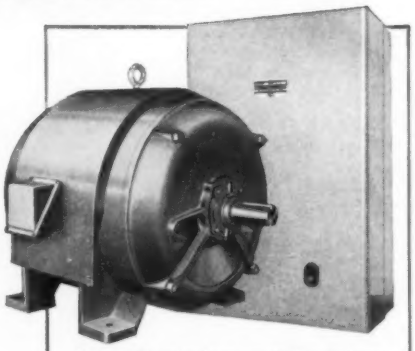

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Practical Methods

Use Standby Generator for Employee Safety

A sudden plant blackout due to power failure could cause employee panic and result in possible serious injury to those operating high speed machines. This thought occurred to a top official of Shwayder Brothers, Inc., makers of Samsonite luggage, as he was standing in the 300,000-sq-ft Denver plant one night when a power failure darkened the entire building for a few minutes. His mental picture of an employee groping in the dark around machinery coasting to a stop led to the installation of an emergency power system to operate critical lighting and power circuits during a blackout.

After thorough study of the problem, Shwayder management decided to obtain a diesel standby generator. The unit chosen is a 90 kw Caterpillar diesel-electric set with a 3-phase generator which provides 220 volts for power and 127 volts for lighting circuits.

The unit is equipped with a special automatic air starting device, designed by the Electric Equipment and Engineering Co., Denver, which automatically provides full power load to the emergency circuit within five seconds after normal power source failure. The engine is pre-conditioned with 60° water circulating in the cooling system.

Special emergency circuits originate at the standby unit and serve critical lighting and heating facility motors. No production machinery is connected to the emergency system. Boiler room emergency power circuits serve fuel pumps and blower motors which must be manually started following a power interruption. Boilers burn oil and/or sawdust—a plant byproduct.

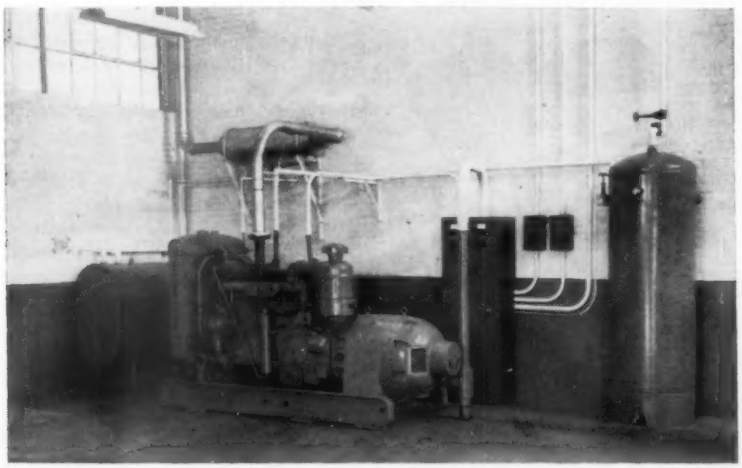
Floodlights on the emergency circuits are stragetically located throughout the plant in the manufacturing area, medical room, halls, stairs, rest rooms, cafeteria and outside all plant exits. Motors operating large overhead doors are also connected to the emergency circuits so employees can have better egress from the plant should the need arise.

Automatic operation of the standby unit is not dependent upon failure of the complete power system. It is so connected that a failure on any of seven key circuits throughout the plant will automatically start the unit and provide power to all lights and motors on the emergency circuit. These seven circuits are so wired that if one of them were completely "killed", the standby could still provide power to the rest of the plant.

While the standby unit and emergency circuits were primarily installed for employee safety, according to Charles Bell, Shwayder Bros. power engineer, they are also used for maintenance purposes. During the last two years, expansion of the Denver plant necessitated rewiring, new transformer capacity, power distribution changes and other work of similar nature. All of this work had to be done at night after manufacturing facilities were shut down.

When such work is done, the emergency generator is started and the entire plant power system shut down if necessary. No circuits need be worked "hot". Floodlights on the emergency circuits provide adequate illumination for the electricians and no portable lighting arrangements are necessary. Emergency circuits have been extended to transformer vaults so floodlights can be connected and work can progress in the vault with the main power shut off.

Aside from the heating equipment and overhead door motors, the only other motors connected to the emergency circuits are the variety of power tools in the maintenance department. This arrangement further increases the efficiency of maintenance and installation operations during such times when the normal power supply must be off.



DUAL-PURPOSE standby 90 kw, diesel electric generator set provides in-plant emergency floodlighting in case of normal power failure at Shwayder Bros., Inc., Denver plant. Unit is used also during electrical maintenance and installation work when main power circuits must be off.

Conveyor Stop-Blocks Speed Bus Fabrication

CONSTRUCTION

When Harlan Electric Company of Detroit was awarded the electrical contract for Chevrolet's new Spring and Bumper Division plant in Livonia, Mich., field engineers began devising methods of coordinating job site fabrication with installation. One of the problems they faced was the fabrication, assembly and installation of some 580,000 pounds of ¼-in. by 4-in. copper bus bar necessary to connect 54 plating generators (15,000 amps, 9 to 15 volts) to three parallel automatic electroplating lines. Each line was approximately 500 ft in length.

To fabricate the thousands of bus sections, offsets and assemblies, Harlan engineers set up a mechanized field-fabrication shop adjacent to the plating lines. Here, parallel lines of roller conveyors progressively fed bus bar from the storage area at one end of the shop, through in-line work stations, to the assembly benches at the far end. Power tools (such as multiple-head drill press and circular saw) were used

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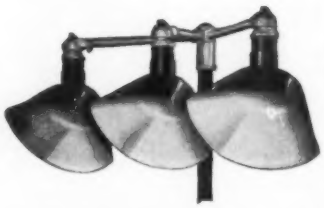

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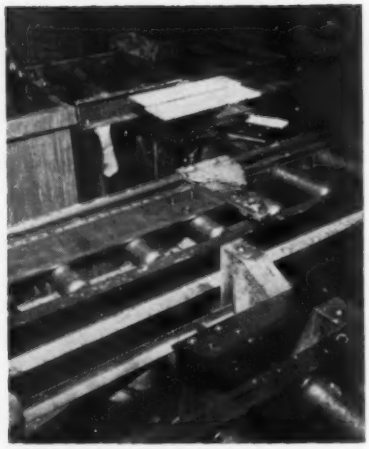


ADJUSTABLE STOP-BLOCK on conveyorized bus fabrication line at jobsite combines with easy-to-read steel tape to eliminate time-consuming hand measurement and layout for cutting and bending thousands of bus bar sections. Block slides along guide rod, spans conveyor width, is held securely at proper dimensional point by hand-operated set screw.

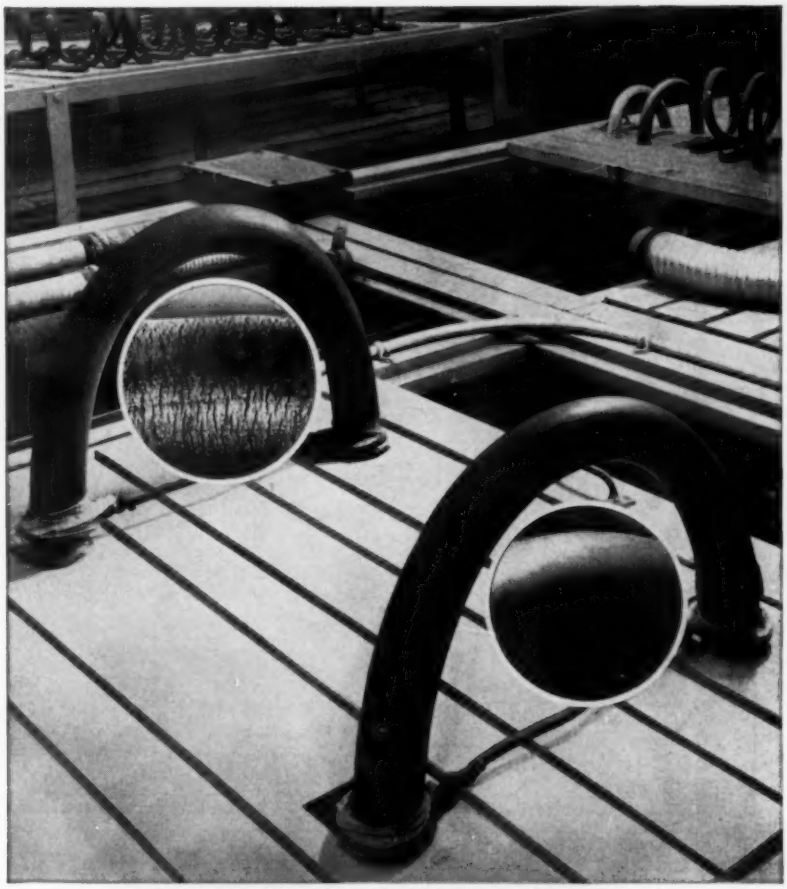
extensively at the fabrication points for cutting, drilling, sanding, plating and bending the individual bus bar sections. Speed and coordination were the key points of the integrated operation.

Contributing substantially to fabrication ease was the elimination of repetitive layout and measurement for multiple bar assemblies plus the tedious conventional measuring techniques on individual bus sections. Instead, each conveyor line feeding or connecting an in-line work station was equipped with an easy-to-read steel tape fastened to the top of the conveyor frame and an adjustable stop-block which could be preset to any desired dimension.

Suppose, for example, eight or 16 bus bars had to be cut to a length of 6-ft. 1-in. (as shown in photograph). The mechanic would set the stop-block at the 6-ft. 1-in. mark on the steel tape. The bus bar would be rolled down the conveyor until it hit the block. The other end of the bar would pass through a positioning jig at the cutting station and the cut made with an in-line circular saw. One setting of the stop-block would suffice for whatever number of bus sections of that length were required.

The stop-block, made from a triangular piece of heavy steel plate, was welded to a substantial collar which slid along a heavy guide rod mounted slightly behind and above the steel tape. A hand-operated set-screw securely held the block in position at the desired spot along the length of the conveyor. The triangular block spanned the width of the conveyor so its apex rested on the frame member opposite the tape. Thus, regardless of align-

Twenty years under the sun



RUBBER-JACKETED CABLE (*left*), NEOPRENE (*right*). Unretouched close-ups show condition of jackets after 20 years' exposure.

—and NEOPRENE cable jacket is still in good condition!

In January 1935, two samples of cable, one with an ordinary rubber jacket, the other with a jacket of neoprene, were placed in an outdoor proving ground. After 20 years of continuous exposure to sun and weather, the natural rubber jacket is badly deteriorated and cracked. The neoprene jacket, on the other hand, is still lively, tough, and as free from cracks as it was two decades ago.

The samples shown here are bent in an arc to put stress on the jackets. This is a standard method of test to show the results of oxidation . . . one of the major causes of failure in rubber materials exposed to sunlight and weathering. Neoprene's inherent resistance to oxidation has made it the outstanding choice for jacket material on wire and cable.

Long-term tests like this prove you can depend on neoprene to give superior protection throughout an extra-long service life. Neoprene resists deteriorating influences no ordinary resilient material could stand. So when you buy wire or cable, make sure it's made to stay on the job . . . make sure it's jacketed with neoprene, Du Pont's chemical rubber.

Remember, of all resilient materials, only neoprene has *balanced resistance* to:

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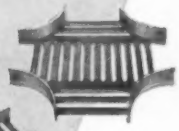

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Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point—insides and bottom always smooth—all sections punched for easy installation—perfect fit at all times. Neat, clean and uniform in appearance.

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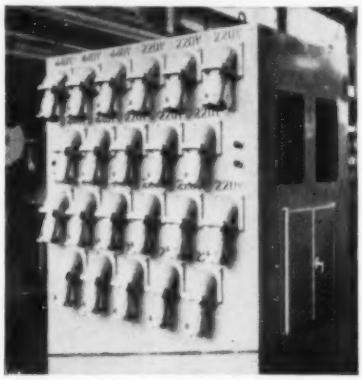
ment, as it came down the conveyor, the end of the bus bar would hit the stop-block.

A similar device was used on the conveyor feeding the hydraulically operated bus bar bender at the end of the fabrication line.

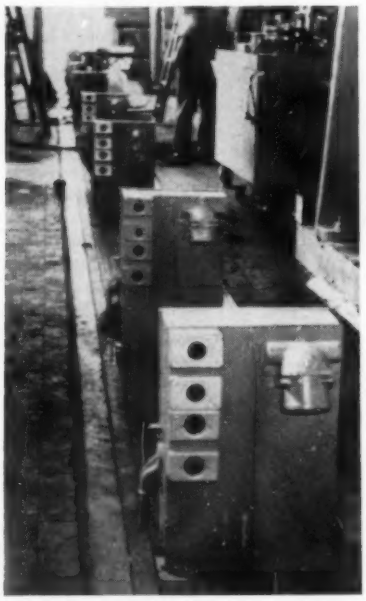
Mobile Power for Tool Testing

PRODUCTION

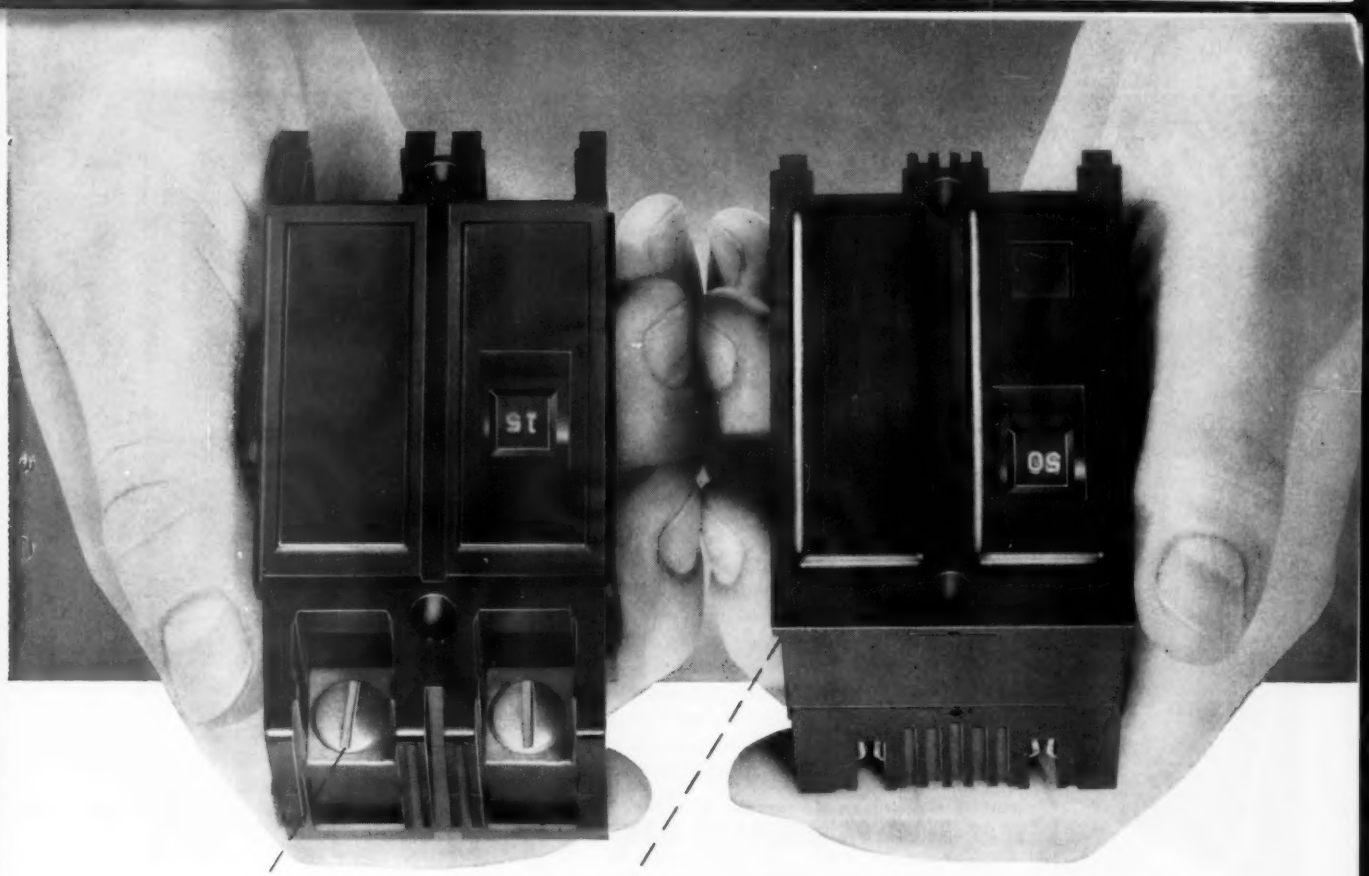
An unusual system of mobile power-stands at a midwestern machinery plant enables production assembly personnel to select a wide range of volt-

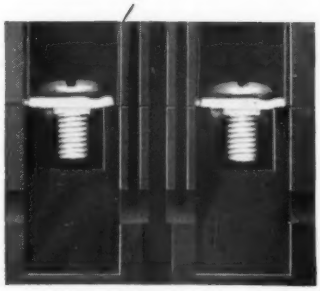


MASTER PANEL in the production assembly of a midwestern machinery plant has a bank of Crouse-Hinds' type AR receptacles to provide any amount voltage up to 550, 2- and 3-phase, for test purposes.

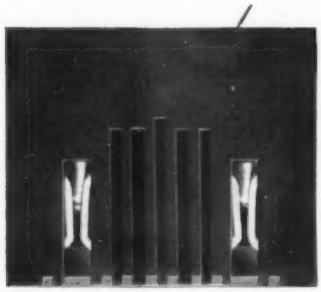


TEST BAY is laid out so that each floor stand can be moved along the metal-covered trough to supply selected test voltages or frequencies to adjacent machines.





"Bolt-on" type breaker completes the Westinghouse Quicklag line—offers a two-pole Quicklag breaker for every application.



"Plug-in" type breaker is firmly gripped by a female line terminal clamp plus pressure contacts on the load end of the breaker.

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Two-pole common-trip Quicklag® breakers —"bolt-on" or "plug-in"

Whatever your choice of mountings, the new Westinghouse two-pole, common-trip Quicklag circuit breaker can now give you more flexible and efficient protection for small-wire general lighting and branch circuits. Available in 15-50 ampere ratings—120/240-volt—for a-c circuits in loadcenters, panelboards, individual applications.

Common-trip bar opens both poles simultaneously with an overload on any one pole. Single handle indicates "trip", "on" or "off". All ratings listed by Underwriters' Laboratories, Inc.

Thermal-magnetic tripping elements, De-ion® arc quenchers, a proven quick-make, quick-break mechanism, and non-welding silver alloy contacts—all combined in electrically isolated compartments—assure protection against small overloads, instantaneous magnetic action against short circuits, and longer operating life. Call your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-30184

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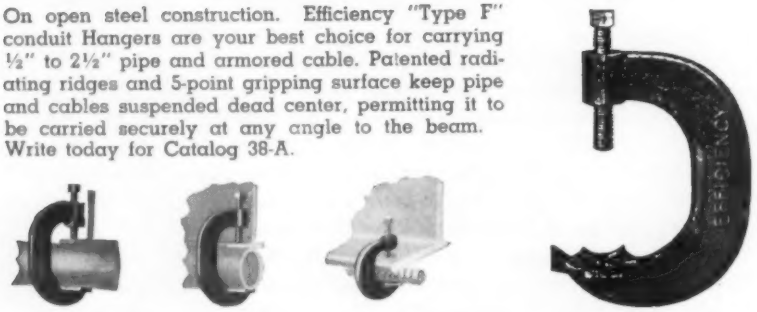

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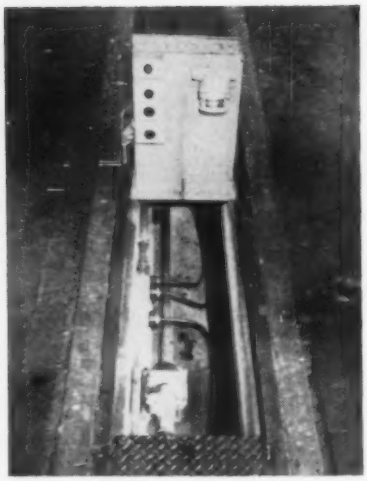


FLOOR STAND contains a type QE receptacle for 3-phase loads, and four type FS receptacles (2- or 3-phase, 180-cycle, 220-volt portable tools, two more for single phase 110-volt extension lighting). A type AR Arktite receptacle, located in the trough, feeds 3-phase voltages to the floor stands.

ages and frequencies for testing machine tools. The system consists of: (1) a master receptacle board from which voltages of 110 to 550 volts may be tapped; (2) a series of adjustable power stands that provide several combinations of power to the machines under test; (3) a metal-covered trough or sub-floor cavity which bisects the floor area of the test bay and contains 3-wire rubber-covered cable and conduit to interconnect the floor stands, master panel and power source. Current capacity for the system of panelboards is 100 amps per cable or outlet.

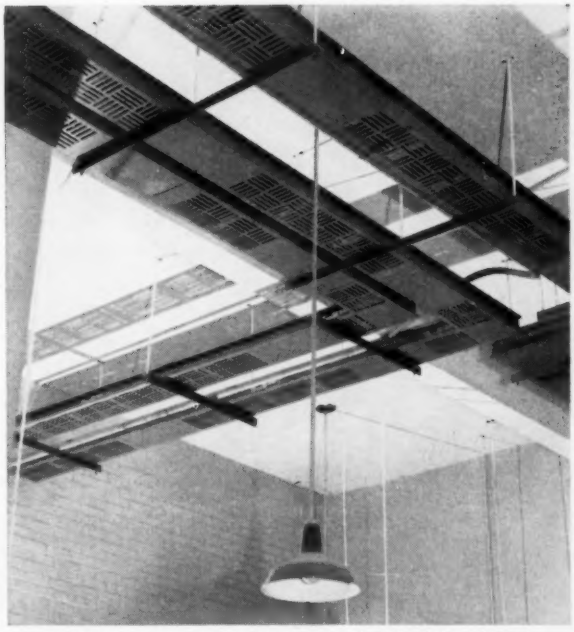
The master panel is equipped with a bank of Crouse-Hinds type AR receptacles to provide any 3-phase voltage.

Each floor stand contains a heavy duty type QE receptacle for 3-phase test loads, and four type FS receptacles. Two of the FS receptacles service 180-cycle 220-volt drills and grinders. Two other receptacles provide 110 volts for portable lamps.

Besides 3-wire, rubber-covered cable for the multiple phase receptacles, the trough also contains ¾-in. and 1¼-in. conduit runs. The ¾-in. conduit carries a 110-volt, single phase service for FS receptacles in the trough. These units activate such tools as buffers, grinders or hand drills. Mounted on the 1¼-in. conduit, AR Arktite receptacles furnish 110-volt, single phase power for testing machines. The two different types—QE and AR receptacles—prevent interchange between single and three phase systems.

Cables remain in floor duct to keep aisles clear for truck traffic, yet allow each floor stand to be moved.

Sub-stations using Kaiser Aluminum tubular conductor combine efficiency and economy.



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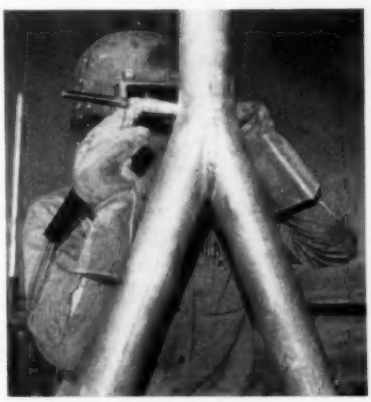

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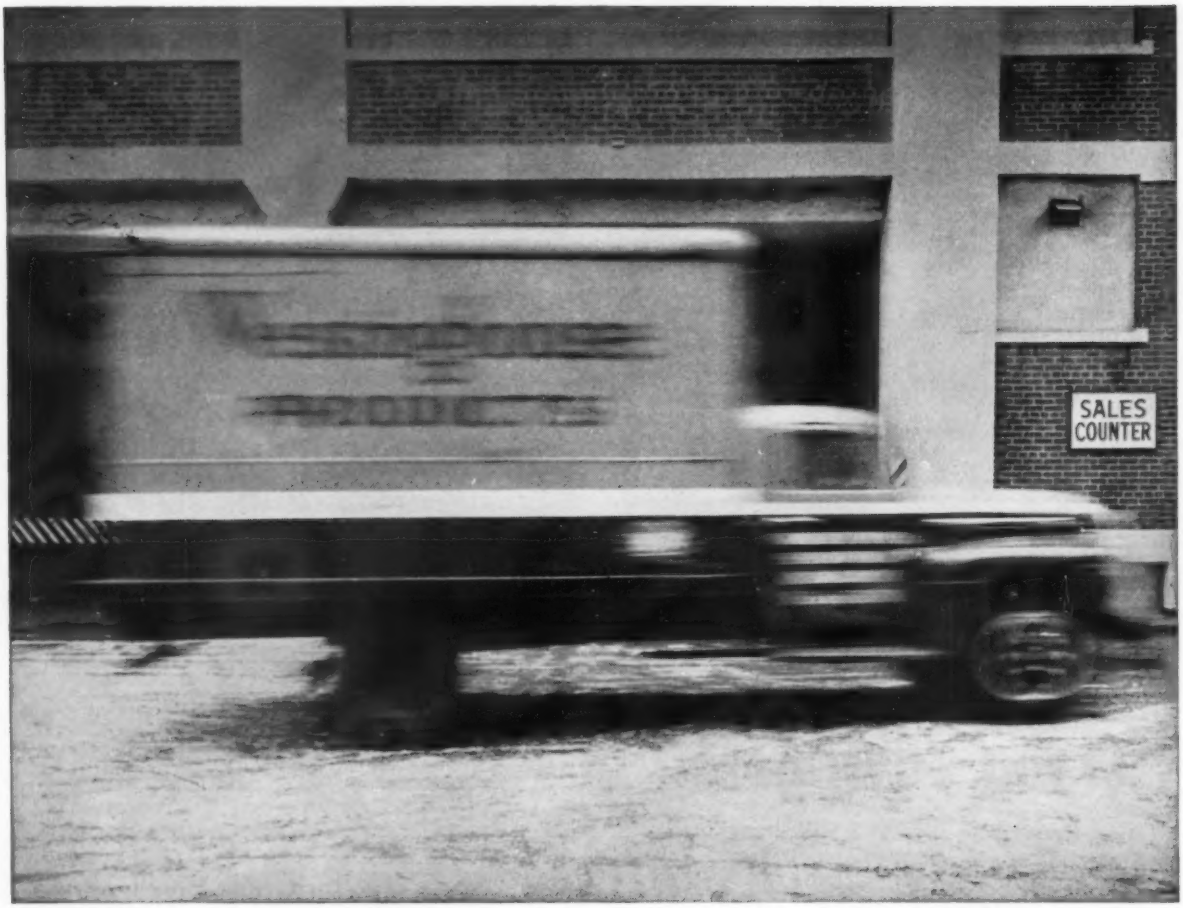

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In The News

Electrical Maintenance Conference, Los Angeles

Preceded by a table top show only, at its kickoff dinner attended by 335, the Electrical Maintenance Conference of the Electrical Maintenance Engineers Association of Southern California put 165 through two days of parallel workshop conferences April 5 to 7 at the University of Southern California Founder's Hall, Los Angeles. Howard F. McCullough, general manager of Service Shops Department, General Electric Co., New York, keynoted the kickoff dinner, talking on "Productive Maintenance—The Key to Effective Management." General Chairman Charles W. Doane, Larsen-Hogue Electric Co., planning and advisory committees set up panels on six aspects of maintenance. These ran in parallel and the registrants selected the sessions they wished to attend and participate in.

The six subjects were "Economics of Planned Preventive Maintenance," of which H. M. Eversz, McCulloch Motors Corp., was chairman; "Maintenance of Electronic Equipment," of which Robert Marcum, Hughes Aircraft Co., was chairman; "Maintenance of Electrical Equipment in Industry," of which Robert E. Clauser, Union Oil Co., was chairman; "Electrical and Safety Codes as They Affect the Maintenance Department," of which Richard Rogers, owner of Ace Day & Night Electric Co., was chairman; "Special Instruments, Tools and Methods Used in Maintenance," of which John J. Singleton, Lever Brothers Co., and EMEA president, was chairman; and "Maintenance of Electrical Equipment in Small Plants—Employing Fewer Than Five Electricians," of which Walter Heiman, vice-president, Tri-State Supply Corp., was chairman.

The four-man panels were made up of experts in each of their fields and they began by giving a short outline of one subject each and then throwing the meeting open to vigorous questions from the audience.

A trip to the Lever Brothers plant ended the conference after a brief talk by C. T. Atwood, manager of the plant, and a final luncheon.

McCullough maintained that a change from the fire department concept of the maintenance department to one becoming a part of the management team was being brought about by the increased complexity of automatic production today.

"It must be remembered that an emergency breakdown during production not only results in lost production and profits," he said, "but also forces upon labor an involuntary strike. Therefore, machinery failure is just as disastrous as a strike when it occurs on a production line geared for high production with a large degree of automation."

South Jersey EL Holds Contractor Meeting

The Contractor Division of the Electrical League of South Jersey met recently in Camden, N. J. to consider and discuss a Bill now before the Senate and General Assembly of the State of New Jersey which would establish an Act to license electrical contractors by the State, and a Board of Electrical Examiners. Also present in addition to League members were electrical contractors from six adjoining counties, invited as guests of the League to participate in discussions of the proposed Bill.

On hand to explain the Bill and its objectives was Judge Owen, attorney who has worked with proponents of the Bill and others in its preparation, and Joe Quinn, manager of the New Jersey Chapter of the National Electrical Contractors Association. After a brief outline of the Bill and its objectives, discussion was invited and participated in by a large majority of those present. In general, the wording and intent of the Bill was clarified at this meeting. The contractors were urged to study the Bill in detail, and be prepared to voice their opinions at the next meeting of the group.

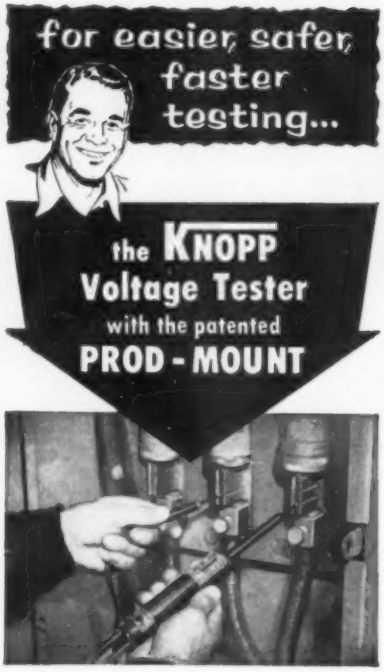
Other speakers at the same meeting were Maurice L. Platt, Advertising Director of the *Courier-Post*, Camden, N. J. newspaper, and Thomas Cluck, also a staff member of the *Courier-Post*. Mr. Platt gave a comprehensive analysis of the economic progress, and market potential for electrical work, in the Delaware Valley area served by the contractors present. Mr. Cluck presented a brief review of the electrical contractors' part in the promotion of the national Adequate Wiring program and benefits to be derived from the program, and then submitted a plan and proposal for a Contractors' Cooperative Advertising program covering the AW program.

AWARD WINNER Robert E. Walton (center), vice-president, Sweney Electric Co., Gary, Ind., proudly holds plaque signifying second place in the Store Lighting classification of the 1954 Lighting Competition for Electrical Contractors sponsored by "Electrical Construction and Maintenance". Congratulating him are: Merrill J. Sweney (left) president Sweney Electric Co., and a NECA governor; and Arthur St. Arnaud, East Chicago, Ind., president of the Lake Counties Indiana Chapter, NECA. August Eckel, middle west editor, "Electrical Construction and Maintenance" presented Mr. Walton with the plaque and a check for $75 at a recent meeting of the Lake Counties contractor organization at the Hotel Gary.

Pittsburgh Lighting Campaign Big Success

The third all-industry Planned Lighting Campaign on stores, offices, schools and factories for Pittsburgh's electrical industry, held under the sponsorship of the Electric League of Western Pennsylvania, came to a successful conclusion in Mid-March with a victory celebration of the remarkable Campaign results in the form of a Planned Lighting Awards luncheon. Over $2000 in cash awards went to 40 winning contestants, along with miscellaneous plaques and certificates.

At the Awards luncheon, attended by nearly 250 members of the electrical industry in the Pittsburgh area, a colorful, dramatized report was presented by a task committee composed of Gordon Maize, Duquesne Light Co., Jack A. Gottfried, Westinghouse Lamp Co., Wm. A. Eisenhauer, General Electric Lamp Department, and Wm. J. Mock, Sylvania Electric Products Inc. Serving as moderator, Mr. Maize discussed the lighting industry's role in Pittsburgh's renaissance, supplementing his discussion with lantern slides. Included in this presentation were the statistical results of this third



has 5 Safety Features . . . many uses

When you get the pace-setting Knopp Voltage Tester you say "Goodbye to risky, time-wasting fuss in testing" because of 5 main safety features: (1) exclusive Prod-mounting Socket in housing making this tester easier, faster, and safer to use, and ending time-wasting "three-handed" testing; (2) protection through dual indication of voltage by solenoid and neon lamp working independently; (3) positive scale readings; (4) signal by hum and vibration; and (5) thorough insulation throughout, even to the sharp point of each prod.

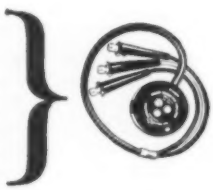
Well-built and shock-proof in a LAMINATED Bakelite housing, the Knopp Voltage Tester tells immediately and simply if circuit is open or closed; magnitude of voltage between 110 and 600; a-c or d-c, pure or rectified; 25 or 60 cycles, for testing old and new circuits, fuses, locating grounds, etc.

Some of the nation's largest utilities, after testing all brands, use Knopp Voltage Testers by the hundreds.

Get the widely-used, reliable Knopp Voltage Tester with the exclusive, time-proved Prod-Mount, and other safety features, from your dealer, or write for illustrated, free, new, descriptive Bulletin No. 425.

THE KNOPP Phase Sequence Indicator

60 v. to 600 v.; 25 to 60 cycles; Rotating Indicator shows sequence A-B-C or C-B-A. Light - weight. Compact. Big time saver.



KNOPP

Electrical Facilities Inc.

4232 HOLDEN STREET, OAKLAND 8, CALIF.

HONORARY PLAQUES presented to electrical contractor and electrical wholesaler organizations for outstanding performances among participants in the 1954-55 All Industry Planned Lighting Campaign in Pittsburgh, were received recently during the Lighting Awards luncheon by (l to r): C. V. Powell, for Keps Electric Company, winner of a plaque three times in succession; Joseph Hartman, for Westinghouse Electric Supply Co., first time winner; and Thomas J. Reilly, for Frame Electric Company, also a third-time winner.

annual four-month Campaign, as well as slides showing the lighting installations which won Awards for the electrical contractors.

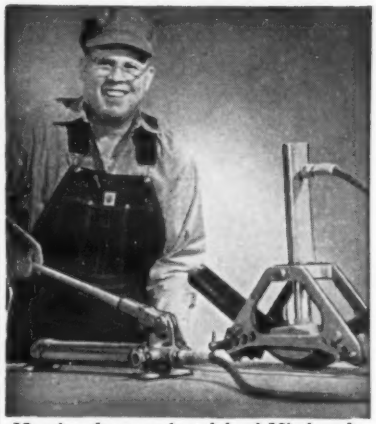
Cash awards were won by 23 electrical wholesaler representatives for their individual sales efforts during the Campaign period of October 1, 1954 through January 31, 1955. The total awards to wholesaler personnel amounted to $1200. In addition, honorary plaques were awarded to Keps Electric Company and Westinghouse Electric Supply Company for outstanding performances among the participating wholesalers.

In the Contractor Competition 17 electrical contractors shared in cash awards of $795 for 18 entries judged the best of a total of 99 entries. In addition, Frame Electric Company was awarded an honorary plaque for the most outstanding performance during the Campaign among the participating electrical contractors.

Cash awards and Award Certificates were also made to F. R. Haubelt, F. R. Haubelt Electric Co., and Thomas J. Reilly, Frame Electric Co., by Berlon C. Cooper, Eastern editor, *Electrical Construction and Maintenance*, sponsors of a national Lighting Competition for Electrical Contractors during 1954, for their four winning entries, two each, in this national contest.

This was the third annual four-month Planned Lighting Campaign to be conducted in the Pittsburgh area, all of which have been successful. Sales results of each campaign have been truly remarkable, Mr. Maize reported, and each one has shown marked increases over the previous Campaign. The results of the recent 1954-55 Campaign measured in number of units sold, dollar value, in-

Why the world's HANDIEST benders also PROVE to be FASTEST!



Here's a happy electrician! His handy, portable Blackhawk Bender permits bench-top as well as floor operation . . . makes kinkless bends, matched offsets and rigid installations easy.

FASTEST . . . because the Blackhawk "Porto-Power" *remotely-controlled* hydraulic jack operates in any position . . . on its side or upright . . . whichever way it's easiest to measure the bend.

FASTEST . . . because it's *really* portable. You can use it on the floor on the bench or overhead on existing pipe runs. And — it's easy to roll or carry to the job.

FASTEST . . . because you can simultaneously pump and sight the job from any angle assure better bends. Can be hand operated or motor driven.

LOW COST TOO!

Example: The S-30A kit for bending 1 to 2" rigid conduit contains powerful "Porto-Power" hydraulic jack and 9 bending attachments . . . costs only $135.45

Price subject to change without notice

BENDERS FOR ALL WORK — For thinwall or conduit up to 4" — Blackhawk Benders pay for themselves in a hurry. Order from leading supply houses or write for catalog 50-B. Blackhawk Mfg. Co., Dept. P-2065 Milwaukee 1, Wisconsin.

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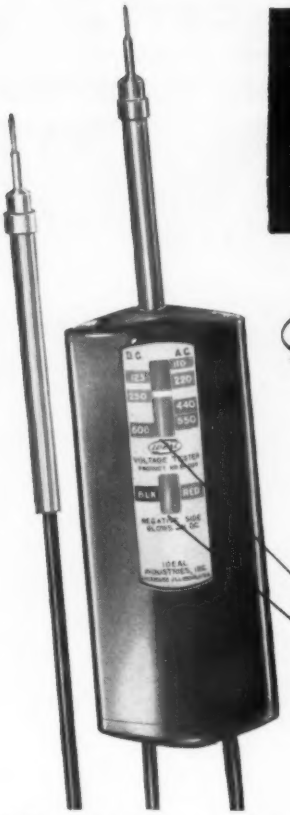
THE TOOLS *Electricians* ask for!



IDEAL VOLTAGE TESTER

- *SUPER SAFE*
- *DOUBLE PROTECTION*
- *CAN'T FAIL TO DETECT VOLTAGE*

. . . has BOTH a solenoid, calibrated indicator AND a neon test lamp — each independent of the other.

Built to take the guess-work and hazard out of all-around testing.

New, handy center mount for the prod —you just hold the tester in one hand, the second prod in the other. Indicator and test lamp are always in the line of vision. Double-strength case, of seamless plastic has no surface metal—plastic name plate is *bonded* to the case. Molded prod handles with "No-Slip" safety rings are mounted on 30" neoprene leads for maximum "reach". Prods are stored safely inside the case when not in use; sharp tips cannot cut or scratch the user.

Built to Last for Years!

Permanently clear, "fog-free" windows over the lamp and indicator seal out dirt. Coil secured at *both* ends and insulated coil leads prevent internal shorts.

Tests for any of these: Nominal voltage from 110 to 550 AC, 110 to 600 DC—whether AC or DC—frequency—DC polarity — continuity — hot lines — grounds — blown fuses.

IDEAL HAS—everything you need to do wiring jobs easier . . . at lower cost.

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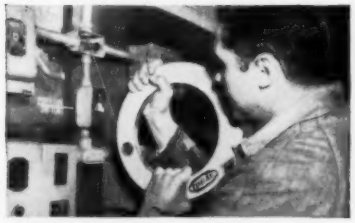
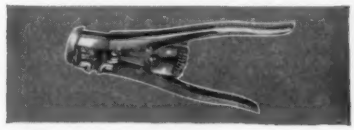
These IDEAL TOOLS are REAL WORK SAVERS

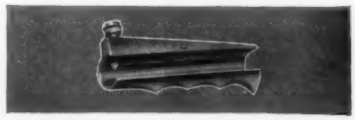
IDEAL WIRE LUBE
Lubricates Wires for Faster, Easier Pulling . . . Protects Insulation
Dries to fine powder; also makes it easy to remove wire from conduit or add wires. Non-corrosive, non-combustible, harmless. For use on rubber, lead or plastic covered wire cable (not for use on asbestos covered.) In quart to 5-gallon containers.



IDEAL FISH TAPES, REELS AND PULLERS
Saves Up to 50% in Fishing Time
The safe, easier way to handle long conduit runs. Reel gives **big** pulling power, keeps tape always under control, protects hands. Five sizes, 50 to 200 foot lengths.



IDEAL "E-Z" STRIPPERS
Patented, No. 2,179,581
Durable, All-Steel Construction
— Fast — Easy to Use
Automatic lock prevents snap back and crushing of stranded wire. Positively will not score or damage wire. Eight sizes for practically all wire gauges, also TV downlead and most non-metallic sheathed cable.



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A Real Mechanic's Tool-Lasts for Years
Rips outer sheath from non-metallic cable up to ½" O.D. Easier and faster—wire goes into cradle from side, no threading into cutters. Replaceable steel cutting blade is adjustable for various size cables. Frame is of aluminum.

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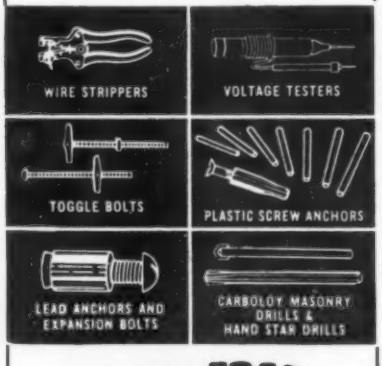
$6.55 VALUE....ONLY $3.95 NET (weight 1 lb.)



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442 ELM ST., SYCAMORE, ILL.

creased kw load, annual revenue, and cost of installation and wiring, provides a good basis for judging its success.

A total of 24,056 fluorescent luminaires were sold, during the Campaign, valued at $600,000. These involved 55,263 fluorescent lamps, valued at $83,000. Also, there were sold 8,254 incandescent and mercury vapor luminaires, valued at $124,000, plus 8,983 incandescent and mercury vapor lamps, valued at $14,000. This lighting business accounted for installation and wiring for the electrical contractors involved in the sale of the equipment valued at $650,000, or about 44% of the total installed cost. This newly installed lighting equipment added a connected load of 5,938 kw, which will provide an estimated $265,000 earned annual revenue (EAR) for the electric utility company.

Participating in this contest with contributions to a Campaign Fund were three lamp manufacturers, 17 lighting equipment manufacturers, nine electrical wholesaler organizations, the Western Pennsylvania Chapter of NECA, and the Commercial and Industrial Sales Departments of the Duquesne Light Company.

IES Regional Conference Meetings at Los Angeles

New tools for lighting, new techniques for using them and some provocative panels on fire safety of luminous ceilings (in Phoenix) and of street and highway lighting for safety (Los Angeles) gave two well attended Illuminating Engineering Society regional conferences plenty of meat to chew on.

The Inter-Mountain regions second and best conference was held at Phoenix, Ariz., in a beautifully lighted auditorium at the Phoenix Library under the general conference chairmanship of J. D. Whitnell, Arizona Public Service Co. and nominee for the region's next vice-presidency. When the conference, April 11 to 12, concluded, the IES Council held an all-day meeting April 13.

The question of fire rating and luminous ceilings was brought before a panel consisting of Bevan Jones, Arizona Public Service Co., moderator; Lloyd LeRaine Pike, architect; H. H. Dinwiddie, Phoenix building inspector; Frank C. Jones, Arizona Fire Rating Bureau; and J. G. Platt, Holophane, Los Angeles. Only conclusion reached was that until further tests are made by Underwriters Laboratories use of a luminous plastic diffuser ceiling in a sprinkler-equipped building can derate the fire rating.

"S-M-O-O-T-H CUTS

—millions of them—

Are Vital in Our Production"

"That's the kind of service we get from UTICA® Cutters and that's why we've been using them for over 5 years, after having tried numerous other makes," says Mr. George Reinhardt, superintendent of molding for Miraplas Tile Co., in Columbus, Ohio.

Miraplas is one of the nation's leading plastic tile manufacturers. Rigid quality control and dimensional perfection are top considerations at Miraplas. The clean, close cuts of UTICA® cutters contribute vitally to this.

Whether you are working in plastics or in metal, you'll find UTICA® cutters, pliers and adjustable wrenches give you long and efficient service.

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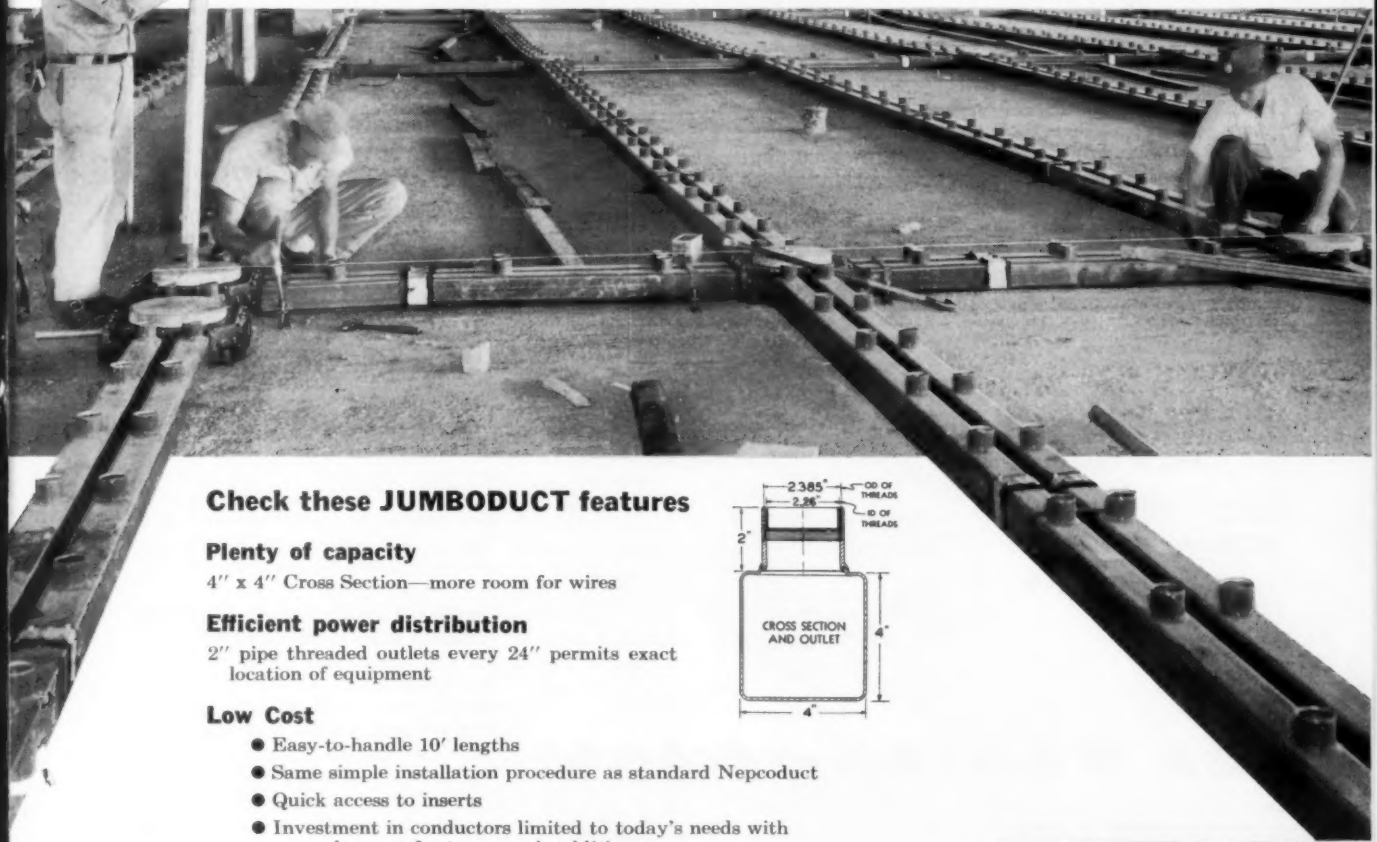
When you build, take a look at

JUMBODUCT

THE HEAVY-DUTY ELECTRICAL RACEWAY THAT PROVIDES EVERY POWER REQUIREMENT IN THE FLOOR

National Electric JUMBODUCT now offers industry three times the capacity previously available plus freedom from the hazards of overhead wiring. It permits flexible, attractive, plant layouts by providing readily accessible electrical underfloor distribution at a minimum investment.



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Plenty of capacity

4″ x 4″ Cross Section—more room for wires

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2″ pipe threaded outlets every 24″ permits exact location of equipment

Low Cost

- Easy-to-handle 10′ lengths
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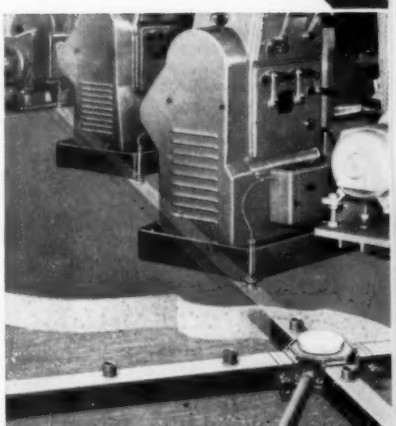
- Protected against corrosion by Sherardizing.
- Coated with a baked-on acid-resisting enamel.
- A completely grounded all-steel system.



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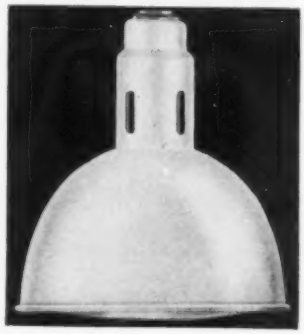
SLOTTED-NECK construction is an original ABOLITE feature! It keeps lamps cooler (40° cooler on a 1000 Watt lamp) — increases lamp life—reduces maintenance. ABOLITE SLOTTED-NECK reflectors keep dirt and dust on the move — they eliminate grime accumulation and maintain better reflectivity over a longer period of time.



ABOLITE ALL-WHITE finish, outside and inside, is the whitest Titanium white porcelain enamel ever developed. This new ALL-WHITE finish will not rust or stain, is impervious to the effects of weather, oil, grease and fumes, and gives plants a clean, modern, efficient appearance.

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ABOLITE Lighting

Get these original ABOLITE features at no extra cost.

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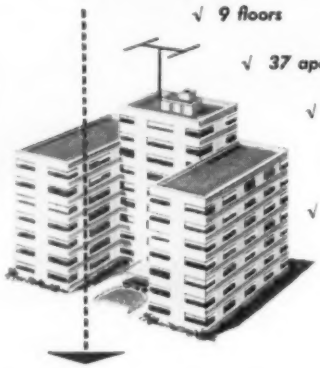

√ 9 floors

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meets every demand of antenna-system specifications for moderate-size buildings, commercial or residential. Master-Tenna is the system backed by the name you know, by RCA and all its technical resources. Master-Tenna costs less than individual antennas . . . pays off in tenant fees for building owners . . . protects their building against rooftop antenna clutter. Master-Tenna means a more popular building . . . assuring sharp reception in UHF or VHF, black and white or color. Your nearby RCA Service Company branch can give you a boost with Master-Tenna estimates, equipment needs, installation and maintenance. Coupon brings the detailed story.

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New light sources described were a new super deluxe white by Sylvania, shown by Dr. Lowry, who also showed the great improvements made in the luminescent panels he first exhibited at the Pasadena convention. A piece of vitreous enameled steel was shown to luminesce and a range of colors possible was also demonstrated.

Kirk Reid proved the filament lamp still very much alive and demonstrated the new sealed beam types which can provide a square or oblong light pattern for floodlighting. Reducing the size of lamp bulbs for higher wattages has about reached its limit, he said, because of the limits of the heat resistance of paper-lined lamp sockets. Beggs demonstrated new mercury vapor lamps of 100-, 150- and 200-watt sizes.

David N. Demaree, electrical engineer, won the Regional Award for My Most Interesting Lighting Job with a description of the lighting of the Holbrook High School gymnasium.

Outstanding feature of the 9th South Pacific Conference at well-lighted Hotel Statler in Los Angeles under the general conference chairmanship of F. J. Rohring, Southern California Edison Co., was a panel on traffic safety lighting April 14. This was headed by L. M. K. Boelter, dean of engineering, UCLA, and had on the panel L. M. Braff, Los Angeles City Traffic Department manager; D. M. Finch, U. of C., Berkeley, Department of Engineering; Dr. Heinz Haber, physicist, Institute of Transportation and Engineering, UCLA; J. E. Havenner, manager, Auto Club of Southern California, Public Safety Department; Dr. Henry A. Knoll, dean of Los Angeles College of Optometry; Dr. G. E. Mount, psychologist, UCLA; A. T. Nadeau, Los Angeles City assistant director, Bureau of Street Lighting; Kirk M. Reid, General Electric Co., Nela Park; H. W. Sullivan, Los Angeles Police Department, Traffic Division; and G. A. Trosper, Pacific Gas & Electric Co., San Francisco. It was organized by Oscar Meissner, chairman of the committee, city of Los Angeles. The panel provided a thorough exploration of every factor involved from the power supply needed for an adequate street lighting job to the psychology of drivers, the interferences of trees and signs, tinted windshields, size of road signs and lettering and eventually fluorescent street lighting.

Renewed interest in garden lighting potentialities was brought to the fore by F. B. Nightingale, a pioneer designer of equipment, that blends with the landscaping itself of the garden.

Regional My Most Interesting

R. A. GEOLLER of Hatzel & Buehler, Inc., New York electrical contracting firm, points up the business potential in commercial building electrical modernization at the recent Edison Electric Institute sales conference in Chicago. Mr. Goeller outlined various modernization techniques and urged local utilities and contractor organizations to combine in a joint effort to convince building owners that their electrical systems must be brought up to modern design standards.

Lighting Job Contest was won by Gordon Dovey, Southern California Edison Co., for a description of the relighting of the Paper-mate Mfg. Co. plant.

The program at Los Angeles was made up of a series of panels on light sources, industrial lighting, floodlighting, office and school lighting and lighting for merchandising. Benjamin S. Benson, Jr., Benjamin Electric Mfg. Co., Des Plaines, treated of the difference between quality and price in well-designed industrial lighting. W. D. Jones, W. J. Moran Co., discussed the use of 480/277 and a newer application of 277/554-volt, single-phase distribution for large area and widespread distribution lighting jobs.

Correlation being attempted now by the office lighting and school lighting committees of IES was discussed by John J. Neidhart, Westinghouse Electric Corp., Cleveland, and Charles D. Gibson, California Division of School House Planning. The latter showed examples of satisfactory combination daylighting and artificial lighting in California schools. E. H. Salter, Electrical Testing Laboratories, New York, brought pertinent information regarding some of the difficulties encountered with ballasts and lamp auxiliary equipment and attempts to arrive at satisfactory standards of performance.

The Los Angeles meeting closed with a quick glimpse of a possible solution to an age-old problem—outside reflections in store show windows in

Try an AMPROBE on the job for 2 weeks FREE

The first time you try it, you'll discover just how useful the Amprobe snap-around volt-ammeter can be—*and how much easier it makes your job!* **We want you to put the Amprobe to the toughest test of all—use it at *your particular job*. See how this one accurate pocket tester meets *all* your testing needs—measuring voltage and current instantly without shutting down equipment. You'll find the Amprobe worth its weight in gold for eliminating guesswork.**

For your FREE two week trial, choose any Amprobe model that fits your needs. If you find the Amprobe doesn't pay for itself many times during the trial period, on job after job, just return it without obligation. The final decision is yours to make—you've got everything to gain and nothing to lose.

Fill out the "Free Trial" form today—we'll arrange for your local jobber to supply you with the Amprobe of your choice. Then take two weeks to show *yourself* how this pocket-sized instrument cuts costs, help you do a better job in less time. Take advantage of this offer today. Don't delay—mail the "Trial Application" coupon now.

AMPROBE "300"

The ideal Amprobe model for general all-around work. Covers 6 ammeter ranges up to 300 amps, and 3 volt-meter ranges up to 600 Volts AC. The tapered probe jaws are perfect for "hard-to-get-at" wires in crowded switch boxes. Comes with test leads and top grain cowhide leather case.

AMPROBES "600 & 1200"

Same multi-range type of unit as the Amprobe "300," but designed to handle extra heavy loads – up to 600 amps and 1200 amps AC. Conductor doesn't have to be centered for accuracy, because of the exclusive toroidal-wound transformer used in these models. Comes with voltage test leads and top grain cowhide leather case.

AMPROBE JUNIOR

New budget economy models to fill a specific job at low cost. This tool now makes it possible for every man who formerly carried an ordinary voltage tester to work with much greater accuracy, and with the added convenience of a real snap-around ammeter. Six models to choose from. Complete with voltage test leads.

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Gentlemen:
I'll take you up on your offer. Please have my local jobber arrange a two week FREE Amprobe trial—at absolutely no obligation to me. I am most interested in the model classification checked below:

☐ Amprobe Jr. ☐ Amprobe "300"
☐ Amprobe "600" ☐ Amprobe "1200"
☐ Send me your latest catalog of testing instruments.

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Vize-an-Ammer

VIZE-AN-AMMER can be used with ordinary shop vise to make rugged high tensile strength solderless terminations.

The VIZE-AN-AMMER can be used with a hammer to make dependable solderless terminations in wire sizes #8 to 1/0.

NEW LOW COST TOOL FOR MAINTENANCE WIRING

A-MP's new VIZE-AN-AMMER crimping tool makes rugged solderless wiring terminations on solid or stranded wire in sizes #8 to 1/0. This lightweight, compact tool is designed for small shop or field use and employs a shop vise or hammer to supply crimping force. The operator, after putting the stripped wire end in the A-MP terminal and placing in the proper crimping notch, simply squeezes or hammers the VIZE-AN-AMMER shut. The resulting diamond crimp has a higher tensile strength than that specified by Underwriters' Laboratories.

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VAP-OIL-TITE CONNECTORS

For Liquid-Tight Flexible Metallic Conduit

The Original and Dependable Split Ring Connector

PREVENTS COSTLY SHORTS and DOWNTIME

The time-proven Simplet Vap-Oil-Tite principle, using a split ring and threaded grounding bushing, insures a permanently safe connection, positively sealed against vapor, oil, water or dust. Compression nut squeezes the grooved split ring, makes it grip the conduit with tremendous pressure, while multiple points of contact between the ring and inside of the connector body provide a perfect seal. Corrosion resistant zinc or aluminum. Write for new bulletin and prices.

SIMPLET ELECTRIC COMPANY
WHOLLY OWNED SUBSIDIARY OF IDEAL INDUSTRIES, Inc.
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the daytime. John S. Walsh, Pacific Gas & Electric Co., illustrated how a San Jose merchant has succeeded in killing window reflections by use of a luminous background in a furniture store display window.

Both of the regions' vice-presidents appeared on the Phoenix program. G. B. Buck II, General Electric Lamp Division, Denver, Inter-Mountain vice-president, gave an excellent discussion of color and lamps at the Phoenix session and an inspirational message "The Light of Your Life" to the president's banquet. Dan Finch, South Pacific regional vice-president, University of California at Berkeley, made a plea to the lighting industry to recruit more engineering students into lighting and support college lighting educational programs.

Eau Claire Adopts 100-amp Service Entrance

A new residential building code recently approved by the Eau Claire, Wis., city council provides that in dwellings and each unit of a duplex up to 3,000 square feet in floor area, the minimum entrance shall not be less than 100 amps with No. 2 conductors. In figuring floor area, the basement is included. In any home over 3,000 square feet in floor area, the electrical inspector will determine the size of the entrance equipment.

J. F. Miller Named Managing Director of NEMA

The appointment of Joseph F. Miller as managing director of the National Electrical Manufacturers Association was announced recently by A. F. Metz, president. Mr. Miller, who has been assistant managing director since August 1, 1954, succeeds William J.

JOSEPH F. MILLER

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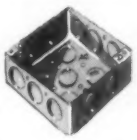
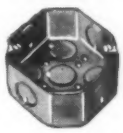
ARROW CONDUIT & FITTINGS CORP.

Manufacturers of a complete line of outlet boxes, covers and box supports. Designed by our engineers, on the job with installation crews. ARROW products answer every modern wiring demand more efficiently.



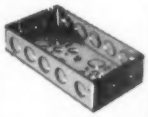
4" SQUARE BOXES
1½" DEEP: Wiring cap. 21.1 cu. in. Any arrangement of K.O.'s up to ¾".
2⅛" DEEP: Wiring cap. 29.9 cu. in. Any arrangement of K.O.'s up to 1¼".
CAT. NO. 4-S-½ • 4-S-71

4-11/16" SQUARE BOXES
1½" DEEP: Wiring cap. 30.5 cu. in. Any arrangement of K.O.'s up to ¾".
2⅛" DEEP: Wiring cap. 43 cu. in. Any arrangement of K.O.'s up to 1¼".
CAT. NO. 5-S-51 • 5-S-71



4" OCTAGON BOXES
1½" DEEP: Wiring cap. 16.5 cu. in. Any arrangement of K.O.'s up to ¾".
2⅛" DEEP: Wiring cap. 24.5 cu. in. With 8 side K.O.'s in any arrangement up to 1"
CAT. NO. 4-O-½ • 4-00-A

CONCRETE RINGS
1½" to 3" DEEP: Any arrangement of K.O.'s up to 1". (One row of 8 K.O.'s).
3½" to 6" DEEP: Any arrangement of K.O.'s up to 1". (Two rows of 8 K.O.'S each).
CAT. NO. 54521-91



GANG BOXES
1⅝" DEEP: Any arrangement of K.O.'s up to ¾". Available from 2 to 10 gangs. Special depths and K.O.'s on request.
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Donald, who retired April 30 of this year.

Mr. Donald retired after 21 years of service as managing director, having first come to the Association in May of 1934. Under Mr. Donald's guidance, the Association grew both in size and prestige until today it has 571 members.

In addition to his association activities, Mr. Donald has been active in the Chamber of Commerce of the United States, the National Industrial Conference Board, and was one of the originators of the Advisory Council on Federal Reports. Because of his outstandingly successful career, he has been generally regarded as the Dean of Trade Association Executives.

Before coming to NEMA in August, 1953, as recording secretary of the Wire and Cable Section, Mr. Miller had been serving as Director of the Copper Division, Metals and Minerals Bureau, of the National Production Authority, Department of Commerce, since September, 1952. He was appointed Deputy Director of the Copper Division in July 1952 and also served in the capacity of Deputy Assistant Administrator of the Metals and Minerals Bureau. Prior to assignment to the Copper Division, he had been an attorney in the Office of the NPA General Counsel, specializing as counsel for the Copper Division and the Tin, Lead and Zinc Division.

NISA News

On May 6 the Niagara Chapter met at the University Club, Syracuse, N. Y., with its newly elected chapter chairman, Ralph Barker of Niagara Falls, presiding. More than forty members and guests attended. The New York Metropolitan Chapter was represented by a delegation of ten.

A new board of directors for the chapter was elected as the primary business of the meeting. Frank Egloff, Glen Wardell, Cort Worth (all of Buffalo), Larry Nelson (Syracuse), and Cliff Nelson (Rochester), were chosen as chapter directors.

It was announced that the Niagara Chapter is preparing arrangements for the 1957 NISA National Convention scheduled to take place in Buffalo, N. Y. Bill Kauppert, vice-chairman of the N. Y. Metropolitan Chapter, applauded this early activity and counseled enlisting the full membership support to make the convention in Buffalo an outstanding success.

Meyer Friedkin, Electric Enterprise Company, N. Y., spoke on the subject of ac motor rewinding of old frames, stressing particularly the conversion of small slip ring motors.

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POWERED CABLE PULLER

READ WHAT USERS SAY!

"Our cable puller paid for itself on the first job."

"Biggest thing in electric construction tools in years!"

"Used it nine months and find it a most useful tool."

"Pushes tape into conduit in minutes . . . took hours by hand."

"Saving in tape cost alone soon pays for this tool."

"Particularly effective pushing snake through long runs and bends."

"Paid for itself rapidly in economy of labor and less fatigue."

THE BARTH CABLE PULLER stops automatically if obstructed...may be used in any position . . . the fish tape is always safely inside the conduit or tool, eliminating dangerous contacts

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Because it's Easy to Use, Fast The "Mighty-Midget" replaces heavy, complicated equipment. It is simple in design, simple to operate. Handle can be used either as a lever or a high-speed crank. Mere 28-lb pressure on handle pulls 500 lb.

Ask your distributor for more information on the "Mighty-Midget" or write for Bulletin ECP.

For Heavier Jobs—stretching heavy guys or cables, laying underground conduits, etc., use a "Safety-Pull" Ratchet Hoist. The ¾-ton model weighs but 14 lb.—eight other models, handling up to 15 tons.

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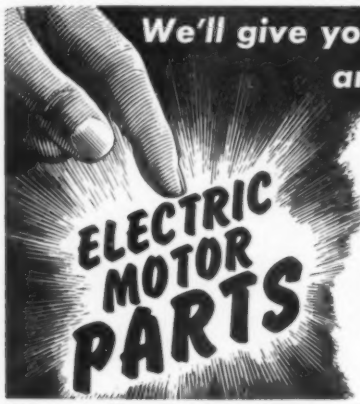

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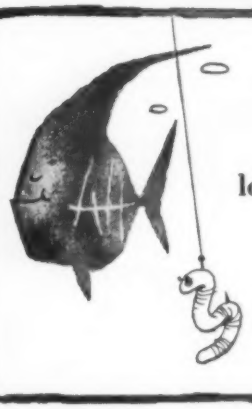

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Larry Nelson, M. H. Salmon Electric Company, Syracuse, showed two G-E films, one explaining "Productive Maintenance", the second "The Development of Atomic Energy."

• • • •

The first annual technical forum on electrical equipment, sponsored by the NISA Southeastern Chapter, was held April 15-16 at the Hotel Selwyn, Charlotte, N. C. Over 175 were in attendance.

• • • •

Carl Lundberg, Cascade Machinery Co., Seattle, was elected director of NISA's new Region 16 by mail ballot last month. Region 16, approved by members in March, included Washington, Oregon, Idaho, Montana and Alaska. Lundberg has been representing the area as a director-at-large for two years.

• • • •

New England Chapter held its annual Foremen's Meeting March 12 at the Hotel Bradford in Boston. NISA National President G. E. Jones and Vice-President Joseph H. Previty headed the list of more than 200 persons who attended. Delegations were also present from the New York Metropolitan and Quaker City Chapters.

• • • •

Starting with a reception Thursday night, March 24, NISA's Southwestern Chapter held its spring meeting at the Galvez Hotel in Galveston, Tex., through March 26.

The program included a discussion on "Latest Dielectric and Heat Characteristics of Mylar" by B. E. McNeill of Houston Industrial Supply, Houston, who told of his findings of the various characteristics of Mylar film, demonstrating them on a hi-pot tester he had built himself.

Al Clot of Peninsular Armature Works, Miami, Fla., demonstrated the elements of dynamic balancing and stressed the value of this type of test.

"New Developments in Equipment" by Paul Potter, Jr., Potter & Rayfield, Inc., Atlanta; "Purchasing and Overbuying" by George M. Brown, president, Insulation & Wires, Inc., Fort Wayne, Ind.; and "Precision Coil Making" by Robert B. James, president, James Equipment Co., Inc., Cincinnati, were presented Friday afternoon.

A Georgia meeting was held for NISA members in that state in Atlanta at the Peachtree Hotel March 5. Attendance was reported as good "with a nice representation from many shops in Georgia," according to state director Sam S. Johnson of Atlanta Electric Machine Co.

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3rd National Electrical Industries Show to Be Held in New York

Successes of two previous National Electrical Industries Shows sponsored by the Eastern Electrical Wholesalers Association have prompted great enthusiasm for the 3rd National Electrical Industries Show, to be produced at the 69th Regiment Armory in New York City, October 11-14th, 1955, according to Harold Meyer, managing director of the show.

Drawing an attendance from electrical contractors, distributors, maintenance engineers, electrical engineers, architects, designers, builders, purchasing agents, lighting engineers, and manufacturers the Show is expected to attract the widest audience ever.

The show will again emphasize adequate wiring importance in the industry. A theme of "Safety Through Adequate Wiring in American Homes and Business" will be reflected in the exhibits of the show.

"Adequate Wiring," says Mr. Meyer, "should mean more than an installation essentially free from hazard. It should mean efficient, convenient and proper wiring for good service. For example, new homes should include wiring in keeping with the trend to 'complete electrical living.' Individual circuits, for example, should be provided in homes for heavy duty appliances such as kitchen ranges, automatic washers, clothes dryers, heating equipment, etc. We have already begun to create interest in adequate wiring, and through our theme again this year, we expect to bring about more adequate wiring everywhere."

A contest to name the "Best of the Show" lighting fixtures will be one of the features of the show.

A second contest to select the "Electrical Installation of the Year" will also be a feature of the show. Selection will be made from photographs. The contest is open to electrical contractors, and the winning contractor will have his name engraved on a new trophy which will be presented to him to keep for one year at his place of business. Photographs accompanied by a typewritten explanation of the nature of the installation and its problems, not to exceed two pages, will serve as a basis for judging entries in the contest. There are no fees in connection with entering the contest. Contest details can be obtained by writing Electrical Contractors Contest, American Electrical Industries Expositions, Inc., 19 West 44th St., New York 36, N. Y. Runners-up will each receive special citations. The winning photographs and explanations will be featured in a display at the show.

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• GROWLERS
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"EXTERNAL" type for finding grounds, shorts and open circuits in armatures .2" to 8" in diameter.

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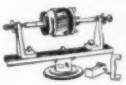

• ARMATURE AND STATOR HOLDER
Positions work for easier, quicker repairing. Rotates on ball bearing in *two* directions.

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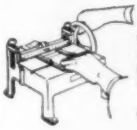

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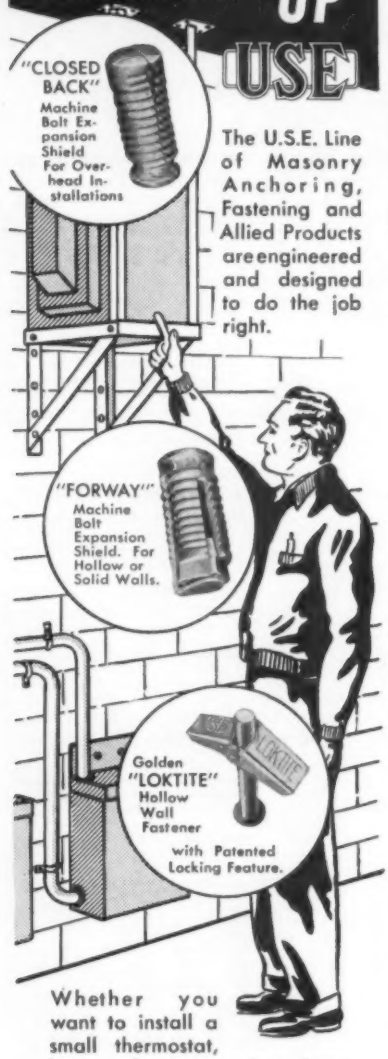
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DATES AHEAD

Edison Electric Institute—Annual convention, Los Angeles, Calif., June 13-16.

New York State Association of Electrical Contractors and Dealers, Inc.—Annual convention, Saranac Inn, Saranac Inn, N. Y., June 27-July 1.

Western Plant Maintenance Show—Los Angeles, Calif., July 12-14.

Illuminating Engineering Society—National Technical Conference, Statler Hotel, Cleveland, Ohio, September 12-16.

National Association of Electrical Distributors—Pacific Zone, annual convention, Empress Hotel, Victoria, B. C., Canada, September 25-28.

International Association of Electrical Inspectors — Northwestern Section, Billingham Hotel, Billingham, Wash., Sept. 12-14; Southwestern Section, Mission Inn, Riverside, Calif., Sept. 19-21; Western Section, Nicollet Hotel, Minneapolis, Minn., Sept. 26-28; Southern Section, Jung Hotel, New Orleans, La., Oct. 3-5; Eastern Section, Mark Twain Hotel, Elmira, N. Y., Oct. 10-12; Canadian Section, King Edward Hotel, Toronto, Ontario, Canada, Oct. 21-23.

Electrical Progress Show—Convention Hall, Philadelphia, Pa., September 27-29.

National Electronics Conference—Hotel Sherman, Chicago, Ill., October 3-5.

International Association of Electrical Leagues — King Edward Hotel, Toronto, Can., October 5-8.

National Electrical Industries Show—69th Regiment Armory, New York City, October 11-14.

N. J. Council of Electrical Leagues—19th convention, Atlantic City, N. J., October 14-15.

National Electrical Contractors Association—Annual convention, Waldorf-Astoria, New York City, October 31-November 4.

Fifth Industrial Electric Exposition—Hotel Wm. Penn, Pittsburgh, Pa., November 1-3.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 14-18.

National Rural Electric Cooperative Assn.—St. Louis, Mo., January 23-26, 1956.

American Institute of Electrical Engineers—Winter general meeting, Hotel Statler, New York, N. Y., January 30-February 3.

Independent Electrical Contractors Assn., Inc.—Annual dinner and dance, Hotel Biltmore, New York, N. Y., February 11.

National Electrical Manufacturers Assn. — Edgewater Beach Hotel, Chicago, Ill., March 12-16.

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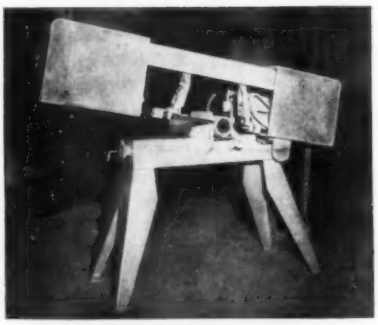

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Headquarters Announcements

International Business Machines Corp., New York, N. Y.—Paul S. Wells, sales manager for Time Equipment Division.

Sylvania Electric Products Inc., Salem, Mass.—Richard G. Slauer, engineering manager for technical products of the Lighting Div.

Electric Products Co., Cleveland, Ohio—G. J. Doss, manager of marketing.

Slater Electric & Mfg. Co., Inc., Woodside, N. Y.—Charles L. Allen, vice president and general manager.

Federal Pacific Electric Co., Newark, N. J.—C. A. Schmidt, product sales manager for AB breakers.

Minnesota Mining & Mfg. Co., St. Paul, Minn.—Louis F. Weyand, sales director.

R. E. Uptegraff Co., Scottdale, Pa. —J. H. Steele, sales manager.

Graybar Electric Co., New York, N. Y.—Douglas Wallace, vice president.

Paranite Wire & Cable Div., Essex Wire Corp., Fort Wayne, Ind.—O. W. Andersen, assistant sales manager.

Kennecott Copper Corp., New York, N. Y.—Paul B. Jessup, secretary; William L. Walsh, assistant to the president.

Lighting Products Inc.—Highland Park, Ill.—Joseph A. Schneller, vice president in charge of sales.

Burndy Engineering Co., Inc., Norwalk, Conn.—George M. Szabad, member of the board of directors.

Holophane Co., Inc., Newark, Ohio —Warren Edman, vice president in charge of street lighting.

General Electric Co., Bloomfield, N. J.—H. N. McMenimen, Jr., manager of sales for the Air Conditioning Div.; Thomas Sproule, manager of manufacturing for the Home Heating and Cooling Dept.

Euclid Electric & Mfg. Co., Madison, Ohio—C. J. Rowles, executive vice president and director.

Sterling Electric Motors, Inc., Los Angeles, Calif.—John R. Howell, vice-president in charge of sales.

Reliance Electric & Engineering Co., Cleveland, Ohio—Richard A. Geuder, assistant general sales manager.

Mitchell Manufacturing Co., Chicago, Ill.—William E. Smith, vice president.

Briegel Method Tool Co., Galva, Ill. —T. W. Briegel, Jr., sales manager.

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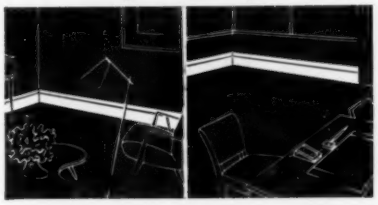

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Located along *outside* walls, these heaters provide true "perimeter heating" through a combination of radiant and convected heat . . . counteract cold downdrafts . . . insure uniform heat throughout the room or office.

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National Electric Products Corp., Pittsburgh, Pa.—Jerome L. Bauer, executive assistant to the vice president in charge of sales; V. P. Oatis, products sales manager; L. D. Shank, distribution sales manager.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Robert S. Stevenson, president; William A. Yost, Jr., vice president, staff operations.

Thomas Industries Inc., Louisville, Ky.—R. W. Minett, Jr., W. L. Tierney, R. W. Krogstad, vice presidents.

Solar Electric Corp., Warren, Pa.—Walter J. Dremann, president.

Square D Co., Detroit, Mich.—James F. Magin, general manager of the industrial controller division.

Westinghouse Electric Corp., Pittsburgh, Pa.—Chris H. Bartlett and Charles C. Shutt, vice presidents; A. G. Tichenor, manager of manufacturing, Industrial Products Div.; Edward C. Huerkamp, manager of Lighting Div.; Allan W. Larsen, sales manager of Lighting Div.

Graybar Electric Corp., New York, N. Y.—Douglas Wallace, vice president and director.

Sylvania Electric Products, Inc., New York, N. Y.—Arthur L. Milk, vice president.

General Electric Co., Waterford, Conn.—Jerome T. Coe, sales manager for silicone products department.

Precision Transformer Corp., Chicago, Ill.—M. L. Butter, sales manager.

Essex Wire Corp., Cords Ltd. Division, Sycamore, Ill.—E. W. Burton, assistant sales manager.

Solux Corp. has relocated to 58-17 28th Ave., Woodside, N. Y.

Harvey Hubbell, Inc., Bridgeport, Conn.—George R. Weppler, vice president and assistant general manager; Jack Beers, assistant sales manager.

Jefferson Electric Co., Bellwood, Ill.—C. L. Coughlin, O. S. Mansell, and George Skakel, Jr., directors.

Permacel Tape Corp., New Brunswick, N. J.—H. M. Sonnichsen, vice president.

Pyle-National Co., Chicago, Ill.—William C. Croft, president.

Schield Bantam Co., Waverly, Iowa—Buel M. Wallis, general sales manager.

Electric Storage Battery Co., Philadelphia, Pa.—H. H. Warren, assistant sales manager, Exide industrial div.

Litecraft Manufacturing Corp., New York, N. Y.—M. D. Holzman, general manager.

Olin Mathieson Chemical Corp., Electrical Div., New York, N. Y.—R. W. Snyder, sales manager.

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QUIET SWITCHES

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In selective or common ringing and semi-selective or common talking. Cost of upkeep is negligible.

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SEARCHLIGHT SECTION

(Classified Advertising)

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Box Numbers in care of our New York, Chicago & San Francisco offices count as one additional line.

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Individual Spaces with border rules for prominent display of advertisements.

The advertising rate is $11.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on one column. 3 columns—30 inches—to a page.

July issue closes June 17th in N. Y.

Employment ADVERTISING: See new section announcement below

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1111 Wilshire Blvd. (17)

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Aggressive representative wanted by nationally known manufacturer of a complete line of Fluorescent and Slimline fixtures, including new type Plexi-glass bottom units. Deliveries prompt and competitively priced, territories open in New England, New York, Pennsylvania, Illinois, Michigan, Texas, Florida, Louisiana, etc. RW-5289, Electrical Construction & Maintenance.

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WANTED

ANYTHING within reason that is wanted in the field of Electrical Construction & Maintenance can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

Attention . . .

EMPLOYMENT ADVERTISERS

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For full information write:

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CLASSIFIED ADVERTISING
330 West 42nd St., New York 36, N. Y.

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Division of
UNITED AIRCRAFT CORP.
45 Bradley Field Road
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- Odd lengths—long and short—reasonably priced

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ELECTRICAL EQUIPMENT AND MACHINERY BY...

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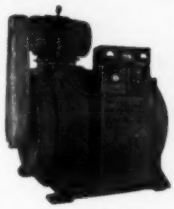

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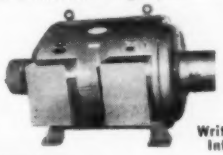
D. C. GENERATORS up to 15 K.W. D. C. MOTORS up to 10 H.P.—with A. C. take-off. HIGH FREQUENCY CHANGERS, MOTOR GENERATOR SETS—D. C. to A. C., A. C. to D. C., 25 cycles to 400 cycles. A. C. MOTORS single phase—1-½—3 H.P.



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SELENIUM & GERMANIUM RECTIFIERS

- *EFFICIENT*
- *DEPENDABLE*
- *LOW COST*
- *PORTABLE*

From 1 to 100,000 Amps.

For Industrial, Laboratory & Plating Use
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SEARCHLIGHT SECTION
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F. J. Eberle, Ass't Mgr.

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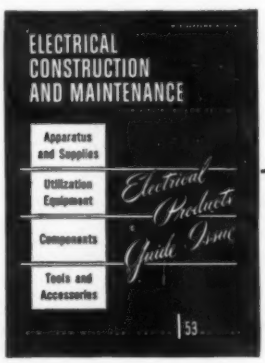

• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE

For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

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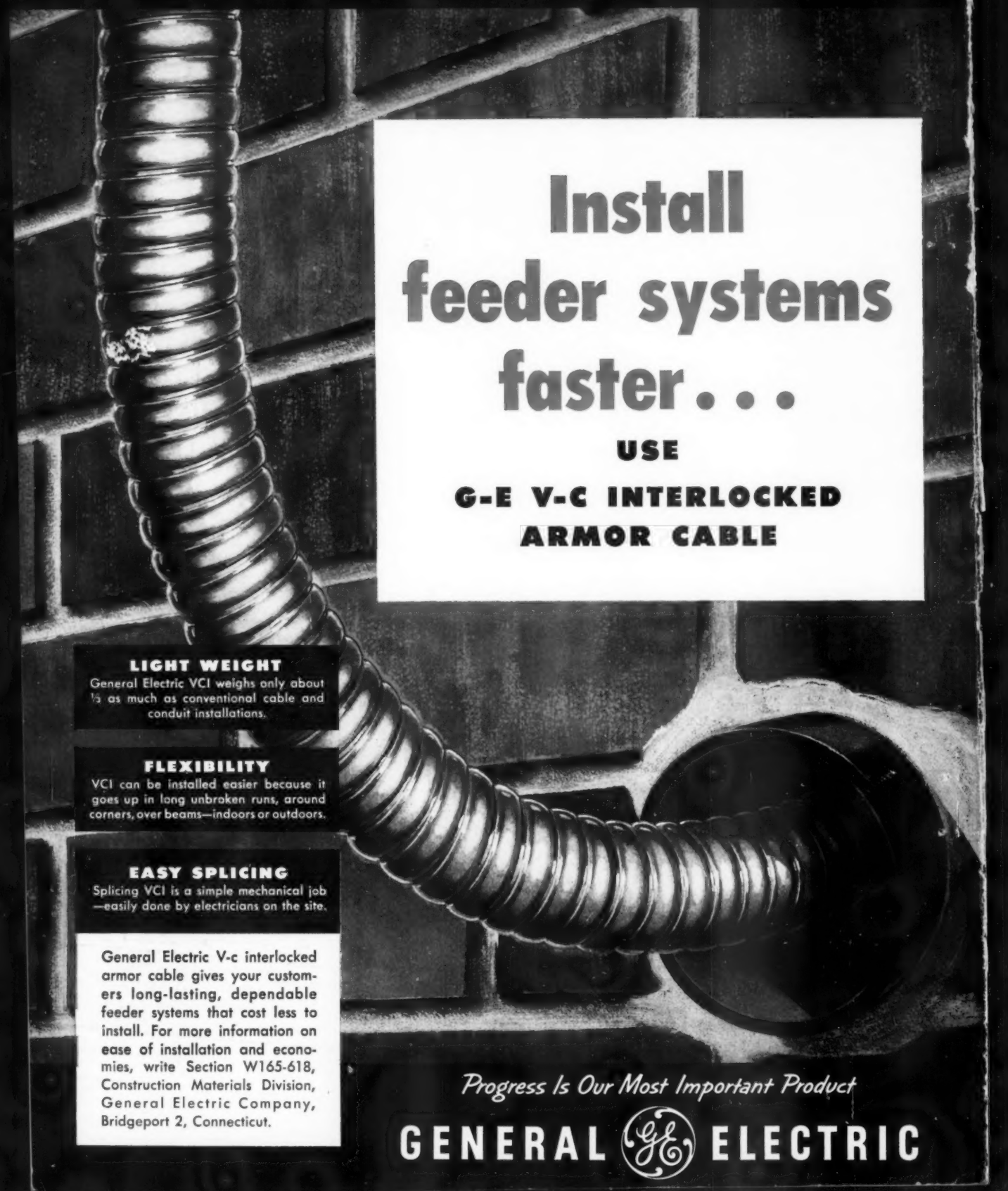
–Never out of First Place in 50 Years!

COMPARE... line for line and feature for feature
THEY COST NO MORE... WHY SETTLE FOR LESS?

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

EASY HANDLING • EASY FITTING
EASY PULLING • EASY BENDING



Install feeder systems faster . . .

USE

G-E V-C INTERLOCKED ARMOR CABLE

LIGHT WEIGHT
General Electric VCI weighs only about ⅓ as much as conventional cable and conduit installations.

FLEXIBILITY
VCI can be installed easier because it goes up in long unbroken runs, around corners, over beams—indoors or outdoors.

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General Electric V-c interlocked armor cable gives your customers long-lasting, dependable feeder systems that cost less to install. For more information on ease of installation and economies, write Section W165-618, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

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GENERAL ELECTRIC